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# *REGIONAL DISPARITIES IN WAGE AND UNEMPLOYMENT RATES IN CANADA: A review of some issues*

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The views expressed in this report are those of the author; no responsibility for them should be attributed to the Bank of Canada.

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## ABSTRACT

In this report the author considers three issues relating to regional disparities in Canada. First, the size of regional disparities in unemployment and wage rates are examined together with the patterns in these disparities over time. Next, various theories related to the causes of regional disparities are reviewed, focussing on their predictions regarding regional disparities in unemployment and wage rates. Finally, the author considers the consequences that regional disparities may have at the aggregate level as the result of aggregation bias. The implications of disparities in unemployment rates for aggregate wage inflation are examined, using the Philips curve framework.

## RÉSUMÉ

Cette étude traite de trois aspects différents des disparités régionales au Canada. L'auteur examine d'abord l'ampleur des disparités de taux de chômage et de salaires entre régions, ainsi que leur évolution dans le temps. Diverses théories visant à expliquer les disparités régionales, en général, et celles ayant trait aux taux de chômage et aux salaires, en particulier, sont ensuite passées en revue. Enfin, l'auteur étudie les conséquences que les disparités régionales peuvent entraîner sur les salaires agrégés à cause des distortions liées à l'agrégation. Les répercussions des disparités du taux de chômage sur la hausse globale des salaires sont analysées à l'aide du schéma logique de la courbe de Phillips.

# 1 INTRODUCTION

Simple multi-region economic models predict that in equilibrium, regional disparities in wage rates and unemployment rates will not exist. Yet this seems never to have been the case in Canada; the existence of regional income disparities since about 1900 has been well documented.[1] The puzzle of why regional disparities exist and what to do about them has given rise to a large theoretical and empirical literature both in Canada and in other countries.

This technical report examines some of the issues related to regional disparities in wage and unemployment rates. Three issues in particular are investigated. The first is the magnitude of regional disparities in wage and unemployment rates in Canada. Regional disparities in these variables are examined in Section 2 to see what patterns, if any, exist in their behaviour over time. Section 3 deals with the second issue: why regional disparities exist. Part of the large literature on the causes of regional disparities is reviewed and conclusions are drawn where appropriate. The third issue, discussed in Section 4, is the implications that regional disparities in unemployment rates and rates of wage increase have for the aggregate rate of wage inflation in Canada. These implications are explored within the context of the Phillips curve relationship between the rate of wage inflation and the rate of unemployment.

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1 See, for example, McInnis (1968), Economic Council of Canada (1977) and Mansell and Copithorne (1986).

## 2 REGIONAL DISPARITIES IN WAGE AND UNEMPLOYMENT RATES: THE STYLIZED FACTS

As noted above, a number of studies have documented the existence of regional disparities in Canada. Two variables that often receive attention in such studies are unemployment rates and average weekly earnings.[2] Here, disparities in these two variables are examined once again. For the purposes of this discussion the ten provinces of Canada have been divided into six regions: the Atlantic region (Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick), Quebec, Ontario, the Prairies (Manitoba and Saskatchewan), Alberta and British Columbia.

To get some idea of the magnitude of regional disparities, one can compare the regional value of a variable with its Canadian average. Regional unemployment rates as a percentage of the Canadian average are plotted in Figure 1, while Figure 2 presents average weekly earnings in each region as a percentage of the Canadian average. Though there have been some changes in the relative positions of various regions over the years, the overall stability of the pattern of regional disparities in average weekly earnings and unemployment rates is remarkable. Between 1966 and 1987, unemployment rates in the Prairies, Alberta and Ontario were almost always below the Canadian average, while those in the Atlantic region, Quebec and British Columbia were nearly always above. Similarly, between 1961 and 1987 average weekly earnings in the Atlantic region, Quebec and the Prairies were always less than the Canadian average, while those in British Columbia and Ontario were generally greater. Alberta is the only province that has changed its relative position for a prolonged period of time; since 1975 its average weekly earnings have been above the Canadian average instead of below.

Figures 1 and 2 suggest that there may be a weak correlation between a region's ranking with respect to unemployment rates and its ranking with respect to average weekly earnings. Those regions with above-average

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2 Provincial unemployment rate data were obtained through CANSIM from the Labour Force Survey. Provincial labour force data were used to aggregate provinces into regions. Data on average weekly earnings were obtained from the Survey of Employment, Payrolls and Hours (SEPH) and were linked to data from the previous establishments survey in March 1983. Both sets of data were also obtained through CANSIM. Employment data from the SEPH database were used to aggregate the provincial earnings data.

Though it would have been interesting to examine disparities in real rather than nominal wage rates, price indices that compare regional differences in the cost of living do not exist. Regional city consumer price indices (CPIs) account for only regional differences in inflation rates, not purchasing power. Because regional inflation rates tend to be quite similar, disparities in real wages constructed using these indices are very similar to disparities in nominal wages.

**Figure 1**
**REGIONAL UNEMPLOYMENT RATES**
**AS A PERCENTAGE OF THE CANADIAN AVERAGE**
**(Canada = 100)**

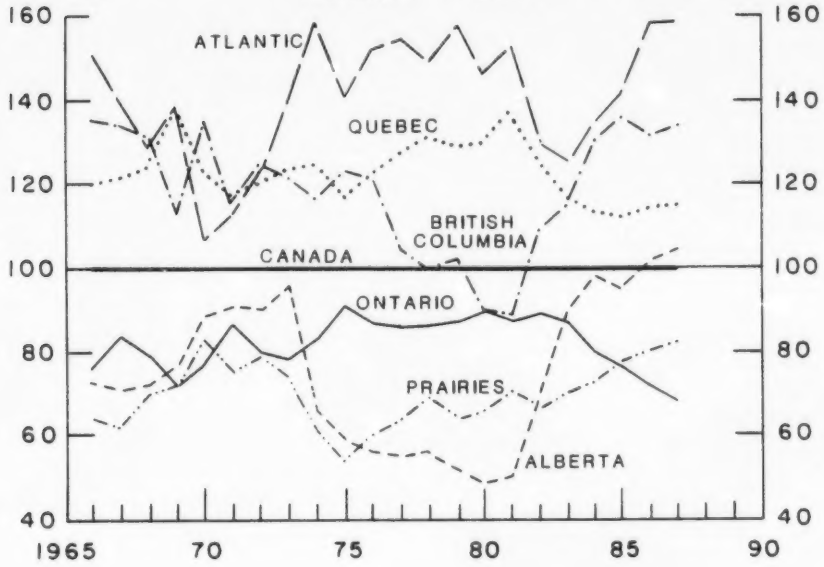
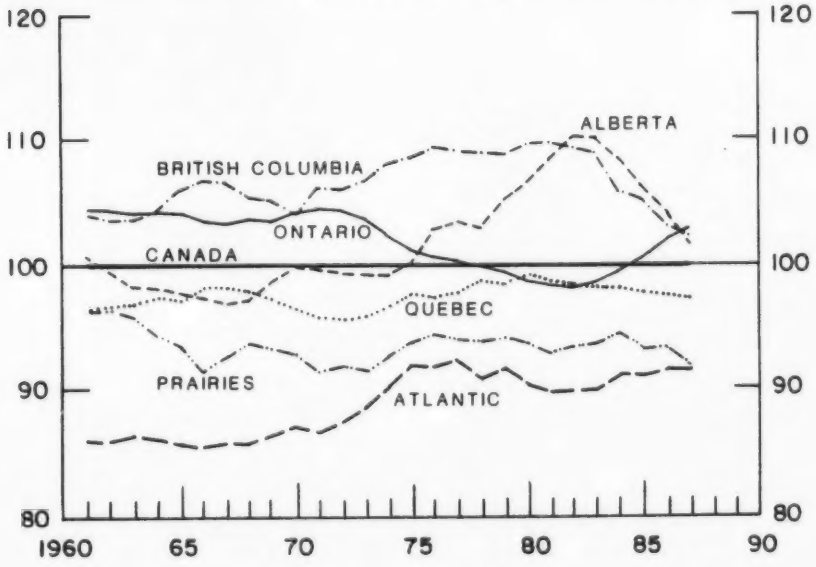



**Figure 2**
**REGIONAL AVERAGE WEEKLY EARNINGS**
**AS A PERCENTAGE OF THE CANADIAN AVERAGE**
**(Canada = 100)**



unemployment rates also tend to have average weekly earnings that are below the Canadian average, and vice versa. The Prairies and British Columbia are exceptions to this rule, however; in the Prairie region both the unemployment rate and average weekly earnings have generally been below average, while the reverse is true in British Columbia. This observation suggests that different factors may be responsible for each region's deviation from the national average.

In some instances Figures 1 and 2 show signs of a link between regional economic performance and movements in commodity prices. This link is most evident in the case of Alberta. After the oil price increases of the 1970s, unemployment rates in Alberta fell and average weekly earnings rose relative to the Canadian average. This improvement continued unabated until the 1982 recession. Since then Alberta's relative position has deteriorated considerably, as has that of British Columbia.

Further examination of Figures 1 and 2 suggests two more stylized facts about regional disparities in Canada. First, regional disparities in unemployment rates seem to have been smallest in the early seventies and in 1983. Second, regional unemployment rates seem to be more widely dispersed about their national average than do regional average weekly earnings. It would be desirable to have some sort of summary measure of regional disparities in order to quantify these observations. Of the many such measures possible, two are examined here: the weighted standard deviation around the Canadian average and the coefficient of variation.[3]

The standard deviation is a measure of absolute dispersion, measured in the units of the variable for which it is calculated. For this reason it cannot be used to compare the degree of dispersion of variables measured in different units, such as average weekly earnings and unemployment rates. In addition, the standard deviation will rise whenever the absolute gaps between regions increase. For example, if average weekly earnings

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3 The weighted standard deviation of a variable X is given by

$$\sigma = [\sum_i \alpha_i (X_i - \overline{X})^2]^{1/2},$$

where the weights $\alpha_i$ sum to 1.0 In the case of unemployment rates, regional labour force shares are used as weights, while regional employment shares are used in the case of average weekly earnings. The coefficient of variation is $\sigma$ divided by the mean $\overline{X}$.

rose by ten per cent in all regions, the standard deviation would rise too, even though each region's position relative to the Canadian average had not changed. Depending on one's point of view, this may or may not be a desirable property in a measure of regional dispersion.

The coefficient of variation, on the other hand, is a measure of relative dispersion.[4] As such, it will not change when all regional variables change by the same percentage amount. It is also unit-free, which facilitates comparisons between variables. However, it may not agree with the standard deviation in its description of the behaviour of regional disparities over time.

The standard deviations of regional unemployment rates and regional average weekly earnings are presented in Figures 3 and 4 respectively. They suggest that regional disparities in both variables have been rising over time. Despite a drop in the standard deviation of average weekly earnings after the 1982 recession, in 1987 dispersion of both variables was quite high relative to previous values.

Figures 5 and 6 present the coefficients of variation of regional unemployment rates and regional average weekly earnings respectively. Unlike the standard deviation, the coefficient of variation of regional unemployment rates shows no obvious trend. Except for the periods 1970-72 and 1982-84, relative dispersion of regional unemployment rates has averaged about 0.27. During those two exceptional periods, relative dispersion of unemployment rates was substantially lower than in other years. However, Figure 5 is consistent with Figure 3 in that both measures indicate that regional dispersion of unemployment rates was fairly high in 1987.

In the case of average weekly earnings there is far less agreement between the two measures of regional dispersion. After a period of relative constancy, relative dispersion of regional average weekly earnings fell between 1971 and 1975, stabilizing at a new lower value for the next few years. Then, in 1980, relative dispersion rose again, only to begin falling again in 1983. In 1987, relative dispersion of regional average weekly earnings was at one of its lowest values ever for the 1961-87 period. Thus, as far as average weekly earnings are concerned, whether or not one believes that regional disparities are high at the present time will depend on whether one prefers absolute or relative measures of dispersion.

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4 The coefficient of variation can also be thought of as the weighted standard deviation of the relative unemployment rate and average weekly earnings variables plotted in Figures 1 and 2.

**Figure 3**
**STANDARD DEVIATION OF**
**REGIONAL UNEMPLOYMENT RATES**

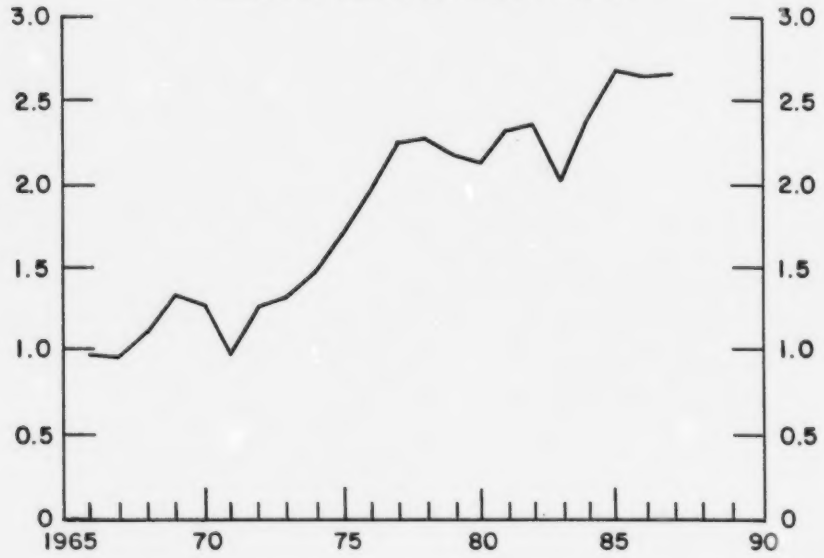



**Figure 4**
**STANDARD DEVIATION OF**
**REGIONAL AVERAGE WEEKLY EARNINGS**

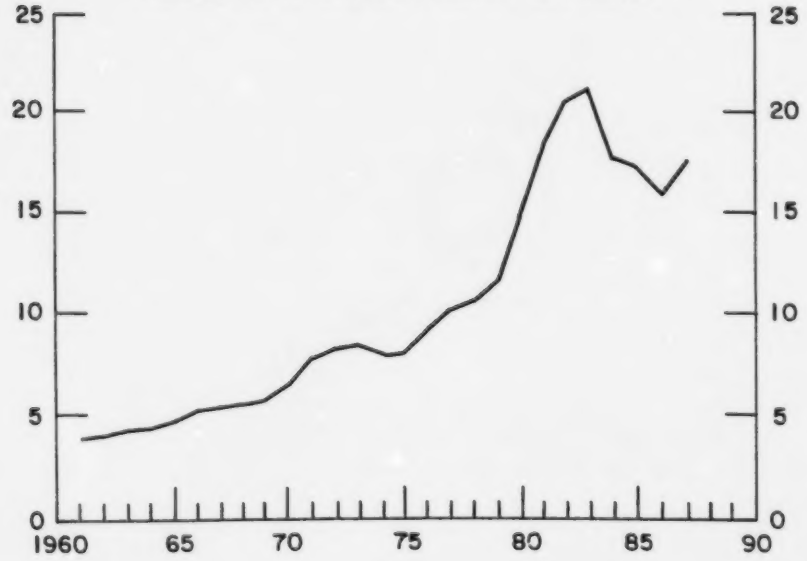


Figure 5
COEFFICIENT OF VARIATION OF
REGIONAL UNEMPLOYMENT RATES

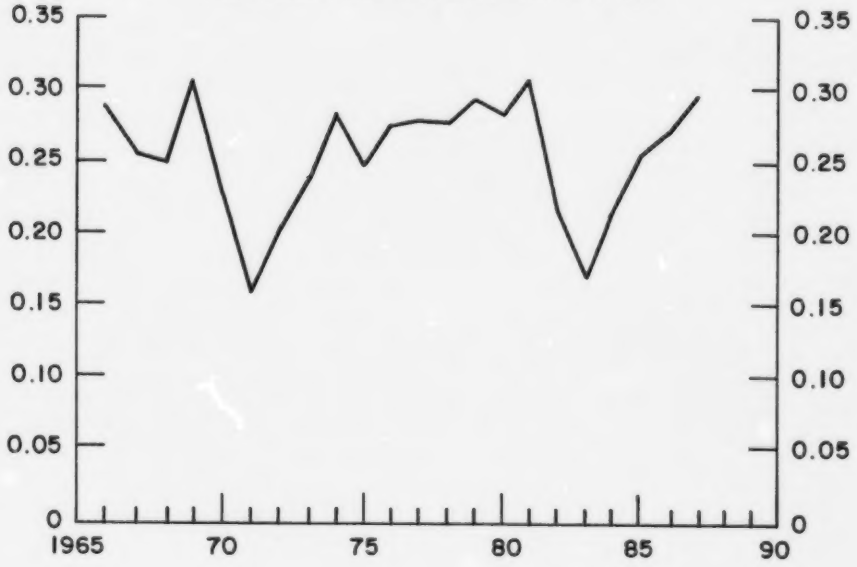
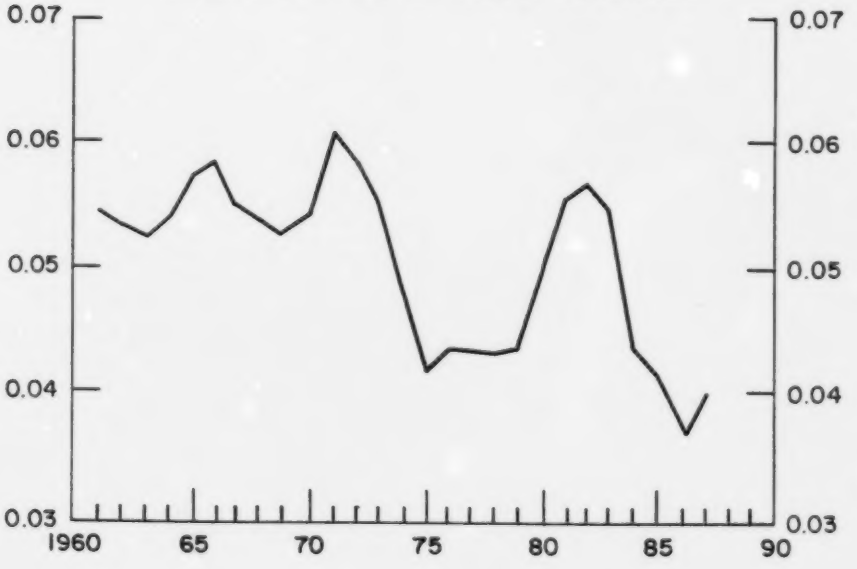



Figure 6
COEFFICIENT OF VARIATION OF
REGIONAL AVERAGE WEEKLY EARNINGS



One final observation can be made by comparing Figures 5 and 6. The relative dispersion of unemployment rates seems to be several times greater than that of average weekly earnings. In other words, in percentage terms the gaps between regional unemployment rates are much greater than those between regional average weekly earnings. In this sense regional disparities in unemployment rates appear to be more significant than those in average weekly earnings.

Another variable that is not always considered in discussions of regional disparities but which may be of interest is the growth rate of wages. This variable is important because of its link to future price inflation. The average weekly earnings data were used to calculate the rate of growth of wages for each of the six regions.

The high degree of stability evident in the pattern of regional disparities in wage levels suggests that regional rates of wage increase have tended to be quite similar from 1961 to 1987. A comparison of the average rates of wage growth for the period 1962 to 1987 tends to support this conclusion; the annual average rate of wage growth ranged from 7.07 per cent in the Prairies to 7.51 per cent in the Atlantic region, with the Canadian average being 7.24 per cent. However, this similarity in average growth rates for the period as a whole masks considerable year-to-year variability, a fact that becomes evident when regional rates of wage increase are plotted relative to the Canadian average in Figure 7. In contrast to the case of unemployment rates and average weekly earnings, the pattern of regional disparities in rates of growth of wages has been very unstable. Instead, the ranking of each region has changed frequently, with no one region tending to dominate the others.

The standard deviation of regional rates of wage increase, shown in Figure 8, also behaves quite differently from those of average weekly earnings and regional unemployment rates. Rather than trending upward over the past twenty years, the standard deviation of rates of growth of wages has fluctuated up and down. A similar pattern is evident in the coefficient of variation, presented in Figure 9. Both measures indicate that regional dispersion of rates of wage increase was quite high relative to past values in 1987.

It is interesting to note that the coefficients of variation of both regional unemployment rates and regional rates of wage increase reached a low point in 1983, only to rise again in subsequent years. A logical question to ask is whether dispersion of these two variables is related in any way. Prior to 1983, however, there does not seem to be any obvious relationship between the degrees of regional dispersion of the two variables.

**Figure 7**
**REGIONAL RATES OF WAGE INCREASE**
**AS A PERCENTAGE OF THE CANADIAN AVERAGE**
**(Canada = 100)**

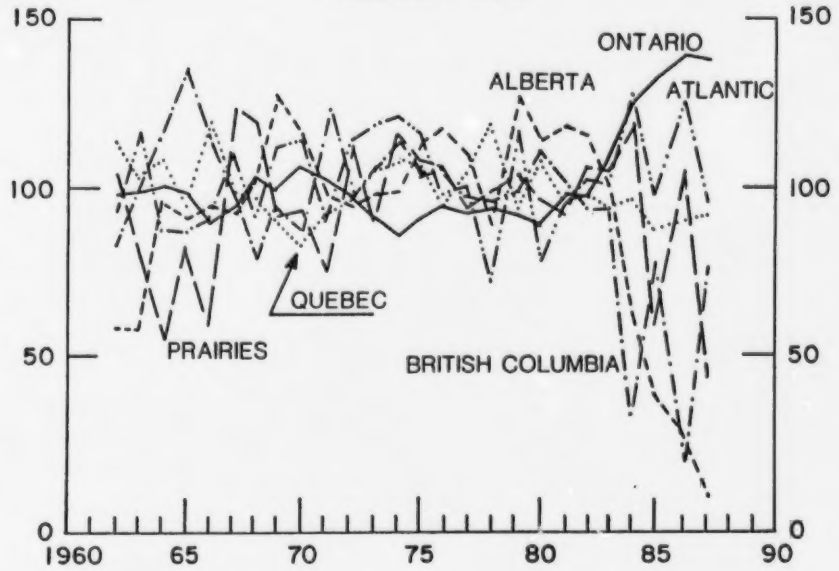



**Figure 8**
**STANDARD DEVIATION OF**
**REGIONAL RATES OF WAGE INCREASE**

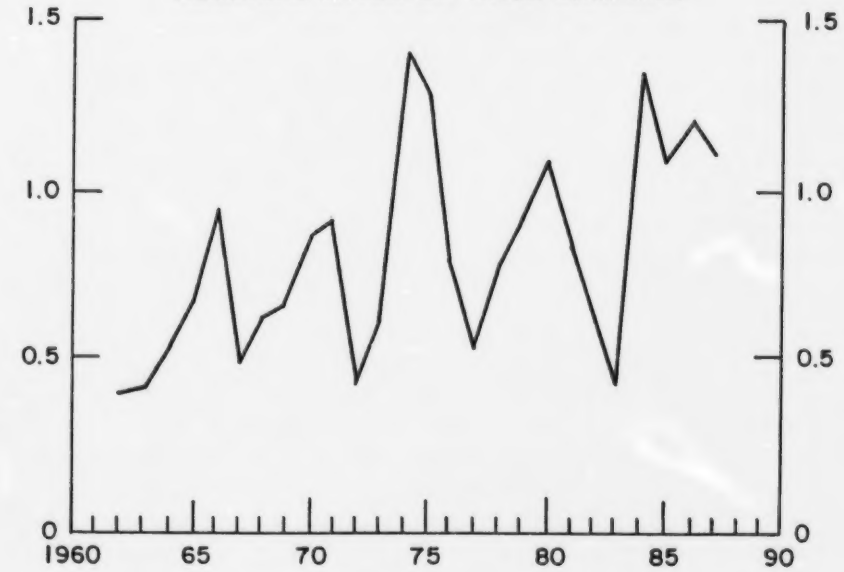
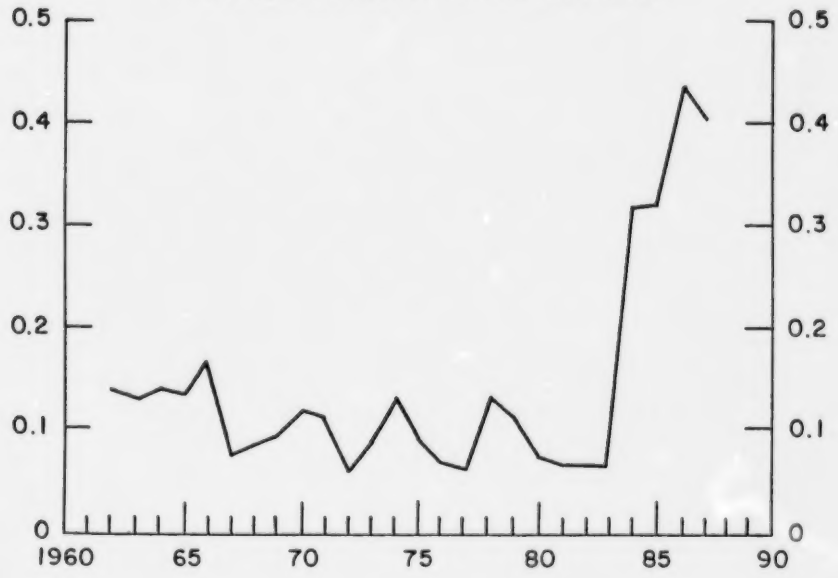


**Figure 9**
**COEFFICIENT OF VARIATION OF REGIONAL RATES OF WAGE INCREASE**




Together Figures 1 to 9 show that regional disparities in unemployment rates, average weekly earnings and rates of wage increase do exist in Canada. Furthermore, the disparities in unemployment rates and average weekly earnings have shown few signs of narrowing over the past twenty to twenty-five years. Though the use of aggregate data may overestimate the actual magnitude of regional disparities, it seems unlikely that all of this measured disparity is illusory (to use the terminology of Melvin (1987a)).[5]

5 As an example of the way in which aggregate data may overestimate the actual degree of regional dispersion, consider the case of a simple economy in which there are two types of labour. If the labour force in each region contains different proportions of each type of labour, then average wage rates will differ across regions even though each type of labour receives the same wage in all regions. Melvin (1987a) used the term "illusory" to describe this component of aggregate regional disparities.

## 3 A SURVEY OF THE CAUSES OF REGIONAL DISPARITIES

Theories that purport to explain the existence of regional disparities abound in the literature on regional economics. There is, however, no one unified theory that completely explains all regional disparities. Instead, there are a number of different approaches to the problem, each of which has something to contribute to our understanding of why disparities exist and what should be done to correct them.

The survey that follows is not exhaustive; rather, it tries to focus on the major approaches to the problem. To clarify the relationships between them, the theories considered have been classified as either static or dynamic. The static models describe short- or long-run equilibriums in economies in which there is no growth. The dynamic models investigate the process of regional growth, with some models predicting the divergence of regional growth rates over time. As each model is reviewed, the emphasis will be placed on its predictions regarding regional disparities in wage rates and unemployment rates.

One shortcoming of the literature on the causes of regional disparities is that there seems to have been more emphasis on the development of theories than on testing them. In large part this may be because of a scarcity of data available at the regional level. Some empirical work has been done, however, and the results of these empirical studies are discussed in conjunction with the relevant theories.

### 3.1 Static models

Four different static models of regional disparities are discussed here. Neoclassical general equilibrium models, in particular models of international trade, are considered first. Trade models are helpful in explaining regional problems because they focus on the problems of resource allocation facing open economies such as regions. However, because most trade models assume that wages and prices are perfectly flexible, equilibrium in these models is characterized by full employment of all factors of production. Therefore, most general equilibrium models focus on explanations for disparities in wage rates, rather than on disparities in unemployment rates.

Models of the "natural" rate of unemployment, discussed next, offer a theory of unemployment rate disparities that fills the gap left by neoclassical trade models.[6] According to this approach, unemployment rate disparities that exist when the economy is in equilibrium can be attributed to regional differences in natural rates of unemployment. Attention is thus directed towards the determinants of the natural rate of unemployment in each region.

Both neoclassical general equilibrium models and models of the natural rate of unemployment assume that wages and prices are perfectly flexible and adjust immediately to eliminate disequilibriums. Another class of models assumes instead that wages and prices are fixed, at least in the short run. The representative discussed here is the Harris-Todaro model, which examines the nature of equilibrium when wages are fixed in at least one sector and labour is mobile between sectors. The model predicts an equilibrium in which both wage and unemployment rate disparities coexist. It is therefore interesting to consider its application to regional problems in Canada.

Finally, that branch of location theory which attempts to explain the location decisions of firms is examined. The theory focusses on the impact of distance and transportation costs on the investment decisions of individual firms. Unlike other theories of investment it ignores the problem of capital accumulation, dealing instead with the issue of where a firm will make a given fixed investment in plant and equipment. Though location theory does not deal specifically with wage and unemployment rate disparities, it helps to explain structural differences between regions, and many regional development policies have been based on its principles.

### 3.1.1 Neoclassical general equilibrium models

Since many of the interactions between regional economies closely resemble those between countries, the neoclassical general equilibrium models of trade theory would seem to be ideal vehicles for the analysis of regional disparities. Trade models applied to regional analysis explicitly incorporate such interactions as trade and factor flows, which should not be ignored when dealing with regions. In addition, some of the assumptions underlying simple trade models – that production functions

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6 The term "natural" rate of unemployment is used to refer to the rate of unemployment observed in a general equilibrium, given the existing structure of markets and institutions. Used this way it is consistent with the concept introduced by Friedman (1968).

are identical in all regions, for example – are more likely to be satisfied in a regional rather than an international context.

Neoclassical general equilibrium models also assume that wages and prices are perfectly flexible and that all markets are perfectly competitive. Wages and prices will adjust to ensure that demand equals supply in both the goods and factor markets. The process of adjustment to equilibrium will involve flows of goods and factors between regions as well as between industries within a region. However, these models focus on the nature of the economy's long-run equilibrium rather than on the process of adjustment to it. Thus, their major contribution is to explain why regional disparities in wage rates might persist in the long run.[7]

A key result in trade theory which provides a useful point of departure for an analysis of regional wage disparities is the factor-price equalization theorem.[8] Recently, Ethier and Svensson (1986) have proved a version of the theorem for the case in which there are two countries, M goods, and N factors of production. All goods can be traded, but not all of the factors of production are free to move between countries. The theorem states that if certain restrictive assumptions are satisfied, then trade in goods and mobile factors of production will equalize the returns to the remaining factors of production in the two countries. Among the sufficient conditions for factor-price equalization are identical production functions in both countries, constant returns to scale, and no restrictions on the trade of goods and the movement of mobile factors of production.

The implications of the factor-price equalization theorem for regional disparities in wage rates depend on whether or not labour is mobile between regions. Assume first that labour is the only factor that is immobile between two regions. Then if the remaining assumptions of the factor-price equalization theorem are met, regional wage disparities will not exist. However, if at least one of the assumptions is violated, disparities will exist. As an example, consider the case of an interregional barrier to trade, such as a tax imposed by one region on one of the traded goods. This barrier to trade will create a wedge between the goods prices in the two regions. Since the prices of all goods are no longer equalized between regions, wage rates will not be equalized either. Similarly, barriers to

7 General equilibrium models of trade are most often used to examine the welfare effects of trade and various government policies. Here, however, the emphasis is on regional disparities in wage rates, not welfare.

8 The factor-price equalization theorem was first proved by Samuelson (1949, 1953-54). A discussion of the theorem can be found in any textbook on trade theory, such as Markusen and Melvin (1984) or Takayama (1972).

capital mobility and increasing returns to scale will also generate regional disparities in wage rates.

Now relax the assumption that labour is immobile. If labour is free to migrate between regions, will barriers to trade and to capital mobility and increasing returns to scale still cause regional disparities in wage rates? In this simple model, the answer is no. Should a gap between wages in the two regions arise as a result of the introduction of an inter-regional barrier to trade, labour will flow between regions to eliminate that gap. Thus, when labour is mobile, the introduction of an inter-regional trade barrier will simply cause a reallocation of labour between regions, rather than a regional disparity in wages.

However, this analysis assumes that the decision to migrate depends only on the real wage. But if there are other factors that differ across regions and enter into workers' utility functions, real wages will no longer be equalized by migration. For example, some individuals would be willing to accept a lower real wage because they prefer a particular climate. Thus, even if labour is mobile between regions, equilibrium will be characterized by regional disparities because factors other than wage differentials affect interregional migration. Examples of such factors include moving costs and regional differences in employment opportunities, amenities such as climate, and the supply of local public goods such as education and health care. Depending on the specification of the model, the magnitude of regional disparities will be determined by the interaction of these factors with increasing returns to scale and barriers to trade and to the movement of other factors of production.

This brief review of models from trade theory has identified a number of factors that can cause regional disparities in wage rates: increasing returns to scale, barriers to trade in goods, and barriers to the movement of capital and labour between regions.[9] The evidence available suggests that these factors do exist and therefore contribute to regional wage disparities. First, consider the question of the degree of returns to scale in

9 There are other assumptions underlying the factor-price equalization theorem which, if broken, would lead to regional disparities in wage rates. One is the assumption of perfect competition. Copithorne (1979) suggests that imperfect competition in the labour market may help to explain the combination of high wage rates and high unemployment rates observed in British Columbia. Melvin (1987a) also provides a brief discussion of the implications of imperfect competition for regional disparities. This potential source of regional disparities is not considered in this study.

regional production functions. If there are increasing returns to scale, the results of Melvin (1987b) would be applicable. Using a two-region model in which industries in both regions exhibit increasing returns to scale, he shows that real factor returns may be affected by the relative size of the two regions. In the standard model with constant returns to scale, factor returns are independent of regional output or factor endowments. When there are increasing returns to scale it is likely that real factor returns will be higher in the larger region – i.e. in the region with larger endowments of capital and labour. Thus, increasing returns to scale may be one of the factors explaining why Canada's largest province, Ontario, has generally had higher wages than other regions.[10]

Some empirical evidence on the degree of returns to scale in Canadian regions is provided by Johnson and Kneebone (1987). They estimate aggregate labour demand functions for Canada and its ten provinces, assuming Cobb-Douglas production functions for each region. Their estimates indicate that the degree of returns to scale for Canada as a whole is 0.974, which suggests that returns to scale may be constant. However, for eight of the ten provinces the estimated degree of returns to scale exceeds 1.0, ranging from 1.125 for British Columbia to 1.726 for Nova Scotia. These results suggest that returns to scale do exist in a number of provinces.

Next, consider the problem of internal barriers to trade. Internal barriers to trade can be classified into two types: natural barriers, such as distance, and barriers arising from federal and provincial government policies. As mentioned previously, the effect of such barriers is to introduce a wedge between the prices of goods in different regions. Since goods prices are no longer equalized across regions, the returns to immobile factors will not be equalized either.

There is considerable evidence that interprovincial barriers to trade do exist in Canada. According to Prichard (1983), the number of policy-induced barriers to trade has been rising in recent years, which suggests that their combined impact on regional economic activity may be important.[11] A survey of the types of barriers in existence as of 1985 was prepared by the Department of Regional Industrial Expansion (1985). Some of the most important policy-induced barriers have been created by liquor regulation, government procurement policies, agricultural policies

10 Melvin (1987b) also shows that under certain conditions, factor flows may exacerbate regional disparities in factor returns when there are increasing returns to scale.

11 Prichard (1983), p. 4.

and various types of subsidies. As an example, in 1985 Ontario's Liquor Control Board applied a markup of 105 per cent on wines imported from other parts of Canada, compared with 57 per cent to 75 per cent on wines produced in Ontario.

As far as capital is concerned, in neoclassical trade models it is the mobility of physical capital that is of interest. Barriers to capital mobility affect regional wages in much the same manner as do barriers to trade. As Ethier and Svensson (1986) demonstrate, the returns to the immobile factors of production (in this case labour) will be equalized only if there is free trade in both goods and the remaining factors of production. Therefore, the introduction of barriers that prevent free trade in capital will also prevent the equalization of wage rates across regions.

Many models simply assume that physical capital is perfectly mobile between regions within a given country. However, recent studies indicate that both the federal and provincial governments have erected a number of potential barriers to the interregional mobility of capital in Canada.[12] Provincial governments may create such barriers by using their tax systems to attract investment to their province, though their ability to do so is limited somewhat by tax collection agreements between the federal and provincial governments. Those provinces that have not entered into tax collection agreements with the federal government have more leeway in offering investment incentives. They include Quebec, Ontario, and Alberta in the case of the corporate tax, but only Quebec in the case of the personal income tax. Quebec's stock savings plan, which was introduced in 1979, is an example of a personal income tax provision affecting the mobility of capital. The program has been quite popular, and in the opinion of Courchene (1983) amounts to a significant impediment to the free mobility of capital within the nation.[13] In the case of corporate income tax, Quebec, Ontario and Saskatchewan all offer special tax credits designed to encourage investment in venture capital entities within the province.

Another type of potential barrier to capital mobility takes the form of direct subsidies to encourage firms to locate in specific regions. Many regional development programs have offered such subsidies, which effectively raise the rate of return to capital in specific regions. Such policies are clearly designed to have an effect on the interregional allocation of capital.

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12 See, for example, Roy (1986) and Sheppard (1986).

13 Courchene (1983), p. 55.

How big an impact are these potential barriers to the mobility of physical capital likely to have on the interregional distribution of capital? The answer depends crucially on whether physical capital is perfectly mobile between Canada and the rest of the world. If it is, then international capital mobility will ensure that all provinces face the same world rate of return to capital. Policies such as capital subsidies will merely increase investment in the target region while leaving investment in other regions unchanged. But if capital is assumed to be imperfectly mobile between Canada and the rest of the world, a capital subsidy in one province will affect the rate of return to capital in all provinces. As a result, the increase in investment in the target province will be accompanied by a reduction in investment elsewhere.

The empirical evidence on the degree of international mobility of physical capital is somewhat mixed. One test of the mobility of physical capital involves an examination of the correlation between savings and investment, the argument being that the lower the correlation between these variables, the higher the degree of capital mobility. Dooley, Frankel and Mathieson (1987) review the evidence on this approach and conclude that it provides strong support for the hypothesis that physical capital is not perfectly mobile. However, their evidence is derived mainly from cross-section studies of groups of countries. Boothe et al. (1985), after studying other types of evidence as well, argue that in the special case of Canada the stylized facts would tend to suggest that the degree of physical capital mobility is quite high over time. In particular, they note that the proportion of the business capital stock owned by foreigners is considerably larger than in other countries, and that official policies concerning capital movements have been quite liberal. Furthermore, studies that estimate the rate of return to capital, while fraught with difficulties, indicate that rates of return are very similar in Canada and the United States. On the basis of these and other observations, Boothe et al. conclude that "the evidence is consistent with very low mobility in the short run and quite high, if not perfect, mobility in the long run."[14] Thus, since international capital mobility may be low in the short run, interregional barriers to physical capital mobility have the potential to affect the interregional allocation of capital in the short run. This in turn implies that interregional barriers to capital mobility may be one cause of regional disparities in the short run.

Labour migration is the regional adjustment mechanism that has received the most attention in the economic literature. As was suggested by the models reviewed earlier, barriers to labour mobility are an impor-

14 Boothe et al., p. 2.

tant cause of permanent real wage disparities. Moving costs, climate, the probability of finding a job, taxes, transfer payments from government and the supply of local public goods are all potential barriers to labour mobility. Empirically, one can determine whether or not these potential barriers are important by testing to see if they have a significant impact on migration decisions.

There have been quite a number of studies of interprovincial labour migration in Canada.[15] One important finding of these studies is that interregional wage differentials have a positive and significant effect on migration. In other words, the flow of migrants from region i to region j will be greater, the lower is region i's wage relative to that in region j. This means that migration flows respond to wage differentials in a manner that should tend to reduce wage differentials. However, these studies have also shown that regional wage differentials are not the only determinant of labour migration. Another important variable is the distance between the origin and the destination. Distance is included in migration equations as a proxy for the monetary and non-monetary costs of moving, such as the cost of leaving family and friends. All empirical studies have found that distance has a strong negative impact on migration flows, which implies that moving costs pose an important barrier to labour mobility.

With respect to other potential barriers to labour mobility the empirical results have been less consistent. First, Vanderkamp (1973) and Shaw (1986) found that language influences migration decisions. This factor is most likely to affect flows of migrants into and out of Quebec and possibly New Brunswick. However, not all studies have included this variable. Second, a number of researchers have attempted to test the hypothesis that employment opportunities or the probability of finding a job will affect migration rates, obtaining mixed results. Vanderkamp (1973) found no evidence that unemployment rates affect migration, but Shaw found that a high unemployment rate at the destination discourages in-migration. Winer and Gauthier (1982) estimated quite a number of migration equations that included unemployment rates, but found that unemployment rates were significant only some of the time. Vanderkamp (1987) tried a different approach, including the employment to population ratio in a net out-migration equation. He found that increased employment opportunities, as measured by this variable, did significantly reduce net out-migration. This brief sampling of empirical studies demonstrates the lack of consistency in the empirical results

15 For example, see Courchene (1970), Grant and Vanderkamp (1976), Winer and Gauthier (1982), Shaw (1986), and the references therein.

regarding the role of employment opportunities as a determinant of migration. Though the hypothesis that increased employment opportunities in a particular region will encourage in-migration seems plausible, the existing empirical evidence does not provide strong support for it.

Finally, most recent studies of migration in Canada have put particular emphasis on policy-induced barriers to labour mobility, such as regional differences in taxation, the provision of local public services and the availability of unemployment insurance benefits. Much attention has been focussed on intergovernmental transfer payments from the federal to the provincial governments. Because such payments allow provincial governments to offer lower tax rates or higher levels of services than would otherwise be the case, out-migration from low-wage, high-unemployment provinces could be discouraged. The federally administered unemployment insurance program may have a similar effect because more generous benefits are available to individuals who live in high-unemployment regions.

Thus far the empirical evidence on these issues has been mixed. Though Courchene (1970) did find evidence that intergovernmental transfer payments inhibited out-migration, the results obtained by Winer and Gauthier (1982) are ambiguous. In the 72 equations that they estimated, fiscal variables were significant with the expected signs only 19 per cent of the time. Shaw (1986) found that the generosity of unemployment insurance benefits in the province of origin had a significantly negative impact on out-migration, but unconditional transfer payments to a region had an unexpected negative sign prior to 1971. Clearly more empirical work is required in this area.

Though the empirical results with respect to employment opportunities and fiscally induced migration are inconclusive, there is ample evidence that interregional wage differentials are not the only determinants of migration in Canada. Future studies based on better model specifications may clear up some of the confusion that remains. In the meantime, it is safe to conclude that barriers to labour mobility do exist, with the implication that regional disparities in wage rates are unlikely to be completely eliminated, even in the long run.

Another question that remains to be answered is the effect of factors such as increasing returns to scale, barriers to interregional trade, and barriers to capital mobility on the magnitude of regional disparities. The effect of these factors cannot be evaluated in a partial equilibrium framework. Instead, what is needed is a general equilibrium model in which the interactions between goods and factor markets are explicitly taken into account. A general equilibrium analysis would also help to

answer the question of whether or not the existence of policy-induced impediments to the free flow of goods and capital between regions can be justified by second-best arguments. For example, Melvin (1985) has shown that in the presence of a national tariff, the welfare of the country as a whole may be increased by interregional barriers to trade. Thus far regional general equilibrium modelling has been used mainly to examine the welfare effects of various types of government polices, not the magnitude of regional disparities. While this work by Whalley and Trela (1986) and Jones and Whalley (1986,1987) is both interesting and valuable, an extension to the implications for regional wage disparities would also be of interest.

### 3.1.2 The "natural" rate approach

In most neoclassical general equilibrium models, equilibrium is characterized by full employment in all regions. However, in macroeconomic models it is generally argued that the unemployment rate will not be zero even in equilibrium. Freidman (1968) defined the unemployment rate that would exist in equilibrium as the "natural" rate.[16] When this argument is extended to the regional case it implies that equilibrium differences in regional unemployment rates can be explained by regional differences in natural rates of unemployment. Models of the natural rate of unemployment thus complement general equilibrium models of regional wage disparities by adding to them a theory of long-run disparities in unemployment rates.

Once the economy reaches this level of unemployment, aggregate demand will equal aggregate supply and there will be no tendency for the inflation rate to change. This equilibrium component of the unemployment rate is often divided into three parts: frictional, structural and seasonal unemployment. Frictional unemployment is defined to be the unemployment that results from labour turnover, as workers search for new jobs. It is generally believed to be of short duration. Structural unemployment, which may be of longer duration, occurs when workers do not have the skills to fill the jobs available in their area. Seasonal unemployment affects workers who are employed in seasonal industries such as agriculture and tourism. Thus, regional differences in natural rates of unemployment can be further decomposed into regional differences in frictional, structural and seasonal unemployment.

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16 For some purposes it is useful to distinguish between the "natural" rate of unemployment and the non-accelerating-inflation rate of unemployment (NAIRU). (See Rose (1988).) This distinction is unimportant for this study.

Several studies have attempted to estimate the natural rate or its components for one or more Canadian regions. One of the first studies in this area was carried out by Thirsk (1973). After estimating Phillips curves, vacancy-unemployment rate relationships, and employment and unemployment equations for each of the ten provinces, he concluded that:

> According to the best estimates of this study, at least two thirds of the unemployment differential between Ontario and the Quebec-Atlantic region is attributable to greater labour market inefficiency in the latter area, while the residual third reflects inadequate aggregate demand diffusion related to rigidity of the interregional wage structure.[17]

This finding implies that over 60 per cent of regional unemployment rate disparities can be explained by regional differences in natural rates of unemployment. More recently, Riddell (1980) attempted to estimate natural rates of unemployment for Canada, Newfoundland and Ontario, using an equation that related the actual unemployment rate to unanticipated inflation, minimum wages, a measure of the generosity of the unemployment insurance system and a measure of the composition of the labour force. His findings, shown in Table 1, indicate that deficient demand accounted for only 12 to 14 per cent of observed unemployment rates in Canada, Newfoundland and Ontario in 1978. Furthermore, the estimated natural rate for Newfoundland in 1978 was 7 percentage points above that for Canada as a whole. Riddell also concluded that increases in the generosity of the unemployment insurance system since 1971 have significantly increased natural rates of unemployment, by about 2.0 to 2.5 percentage points in Ontario and about 7.2 to 8.5 percentage points in Newfoundland. The differences between the two provinces probably resulted from the introduction of regionally extended benefits and fishermen's benefits in 1971. These changes greatly increased the generosity of the unemployment insurance system in Newfoundland relative to Ontario.

A more recent study, which estimates natural rates of unemployment for Canada as a whole and five regions (Atlantic provinces, Quebec, Ontario, Prairie provinces and British Columbia) is Miller (1987). For each region Miller estimates an unemployment rate equation similar to that of Riddell. For ease of comparison, only his estimates for 1978 are presented in Table 1. For all regions, Miller's estimates tend to be higher than those of Riddell, perhaps because of the strong performance of a demographic variable defined as the combined labour force participation rates of young

17 Thirsk (1973), p. 129.

Table 1

A SURVEY OF ESTIMATES OF REGIONAL NATURAL RATES OF UNEMPLOYMENT*

| | Riddell (1980) Natural Rate 1978 | Miller (1987) Natural Rate 1978 | Wilson (1981) Seasonal Rate 1970-78 | Postner (1980) Frictional Rate 1977 | Lazar (1977) Frictional Rate 1966-73 |
|---|---|---|---|---|---|
| Newfoundland | 14.5 (16.6) | | 2.3 (11.3) | 2.3 (16.4) | |
| Atlantic | | 9.7 (12.5) | | | 1.9 (7.2) |
| Quebec | | 10.6 (10.9) | | | 2.0 (6.5) |
| Ontario | 6.5 (7.5) | 7.2 (7.2) | | | 1.2 (3.5) |
| Prairies ** | | 5.2 (5.2) | | | 0.7 (3.2) |
| British Columbia | | 9.1 (8.3) | | | 2.2 (5.8) |
| Canada excluding Newfoundland | | | 0.9 (6.6) | | |
| Canada | 7.4 (8.4) | 8.1 (8.3) | | 2.4 (8.4) | |

* Actual unemployment rates are shown in parentheses. These may differ from study to study because of data revisions.

** Here the Prairie region includes Manitoba, Saskatchewan and Alberta.

and female workers. More importantly, he tests for equality of the coefficients in his five regional equations and finds that the differences in coefficients are statistically significant. This implies that differences in regional natural rates are also significant.

The work of Miller and Riddell suggests that a large portion of the observed regional disparities in unemployment rates is due to regional differences in natural rates of unemployment. It is therefore important to ask why these differences exist. Riddell's work supplies part of the answer, namely the greater generosity of the unemployment insurance system in some regions. His estimates suggest that this factor may account for about five percentage points of the difference between the Newfoundland and Ontario unemployment rates. Other studies have tried to answer this question by studying the different components of the natural rate, in particular seasonal and frictional unemployment. Unfortunately, most of the work in this area has been confined to comparisons between Newfoundland and the rest of Canada. Wilson (1981) found that seasonal fluctuations in unemployment were definitely more pronounced in Newfoundland than in the rest of Canada, though their importance had declined considerably in both areas over the 1953-77 period. As shown in Table 1, his estimates indicate that seasonal fluctuations accounted for 20.4 per cent of Newfoundland's unemployment rate over the 1970-78 period, compared with approximately 14 per cent for the rest of Canada. These seasonal fluctuations were not due to a greater preponderance of seasonal industries in Newfoundland, but to greater seasonality relative to the rest of the country in all of Newfoundland's industries. Wilson also found evidence that the unemployment insurance system has exaggerated the seasonal fluctuations in some Newfoundland industries.

Postner (1980) examined frictional unemployment in both Canada and Newfoundland. Though he emphasizes that the unavailability of certain data prohibits one from making precise estimates of the frictional unemployment rate for either Canada or Newfoundland, his rough calculations suggest that in 1977 the frictional rate was about 2.3 per cent for Newfoundland and 2.4 per cent for Canada. Since these frictional rates are quite low, they suggest that differences in frictional unemployment are not responsible for the large gap between the Canadian and Newfoundland unemployment rates. Also, since Newfoundland's unemployment rate is higher than that of Canada, frictional unemployment accounts for a much greater proportion of actual unemployment in Canada than in Newfoundland.

Lazar (1977) also estimated frictional unemployment rates for the five Canadian regions using data on flows into and out of the labour force. His estimates, which are averages for the 1966-73 period, are also

reproduced in Table 1. They indicate that frictional unemployment was lowest in Ontario and the Prairies and highest in British Columbia. However, because Lazar and Postner use different methods of estimating frictional unemployment, it is not possible to use their results to make inferences about changes in frictional unemployment over time.

This review of the empirical evidence suggests that more than half of Newfoundland's unemployment is due to structural problems. Extrapolating these results to other regions would imply that disparities in unemployment rates are due largely to regional differences in the rate of structural unemployment. One of the factors underlying these structural differences was found to be the unemployment insurance system; the other factors remain to be identified. To date no study using Canadian data has tried to link regional differences in structural unemployment to preferences for levels of government services and other amenities available in a particular region.[18]

### 3.1.3 Models with wage and price rigidity

One distinguishing feature of neoclassical models is their assumption that wages and prices are perfectly flexible. This assumption ensures that all markets will clear in equilibrium. If instead one assumes that prices and wages are fixed, then only quantities can adjust to reach an equilibrium. An example of a model that incorporates both wage rigidity and labour mobility is that of Harris and Todaro (1970). They wanted to explain the phenomenon of continued rural-to-urban migration in some developing countries, despite rising urban unemployment and a positive marginal product of labour in the agricultural sector. To do this they constructed a dual labour market model, postulating that wages were perfectly flexible only in the agricultural sector. In the urban manufacturing sector, firms were required to pay workers a fixed minimum wage that exceeded the agricultural wage. The crucial assumption of the model was

18 Marston (1985) uses microdata for the United States to show the relationship between intermetropolitan unemployment rate differentials and amenity levels. However, his methodology is strictly valid only if current unemployment rates represent a long-run equilibrium. The first part of his paper attempts to show that the economy is indeed in long-run equilibrium, because there is no first-order autocorrelation in metropolitan unemployment rates. This conclusion can be criticized on two grounds. First, his time series consist of only five years. Second, he pooled time-series and cross-section data, implicitly assuming that the autocorrelation coefficient was the same for all metropolitan areas. If some area unemployment rates exhibit positive autocorrelation while in others the autocorrelation is negative, these effects might cancel each other out to produce a zero autocorrelation coefficient for the entire sample.

that individuals would continue to migrate to the urban sector until expected wages in both sectors were equal:

$$(1-u)w_U = w_A, \qquad (1)$$

where $w_U$ is the fixed urban wage, $w_A$ is the wage in the agricultural sector, and u is the probability of being unemployed. Equilibrium would therefore be characterized by disparities between the two sectors in both wages and unemployment rates.

Zylberberg (1985) extended the Harris-Todaro model by adding a goods market. In his general equilibrium model one homogeneous good is produced by two sectors. In one sector wages are downwardly rigid, as a result of the existence of a minimum wage, while in the other sector wages are perfectly flexible. The price of output is also inflexible downwards. One of the conditions for equilibrium is that expected utility be the same for workers in both sectors of the labour market; this condition is a generalization of condition (1). Zylberberg's model thus combines the Harris-Todaro model with more recent microeconomic disequilibrium models.

The application of the Harris-Todaro model to regional problems in Canada has been considered by Boadway (1981). Usually it is assumed that wages are rigid in the low-wage, high-unemployment region, not the high-wage region. High unemployment rates in the low-wage region can therefore be sustained only if there are barriers to mobility such as moving costs. A migration equilibrium will occur when

$$(1-u_p)w_p + m = (1-u_R)w_R\,, \qquad (2)$$

where $u_p$ is the probability of being unemployed in the poor region, $w_p$ is the annual wage rate in the poor region, m is the cost of moving from the poor to the rich region, $u_R$ is the probability of being unemployed in the rich region, and $w_R$ is the annual wage rate in the rich region.[19] One could also consider the case where wages are fixed in both regions. In this case migration would serve to redistribute unemployment across regions without altering wage rates.

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19 If wages are assumed to be rigid in the low-wage region, with $(1-u_p)w_p < (1-u_R)w_R$, individuals will migrate to the high-wage, low-unemployment region. The unemployment rate in the low-wage region will fall, as will $w_R$. In the absence of moving costs, equilibrium would be reached when the expected wage rate was the same in both regions. If $w_p$ remained below $w_R$ in this new equilibrium, $u_R$ would have to exceed $u_p$.

This latter version of the model may provide a good description of the Canadian situation. As discussed earlier, some studies have found evidence of wage rigidity in Canadian regions. Furthermore, Wrage (1981) and Vanderkamp (1987) have found that migration has little effect on wages but does seem to have an impact on either unemployment rates or employment growth. This finding supports the hypothesis that wages are rigid in the short run. If so, the observed pattern of regional unemployment rate disparities may represent a short-run equilibrium for the Canadian economy.

The most important contribution of the Harris-Todaro model, however, is its view of the relationship between migration rates, unemployment rates and wages. If migration decisions do depend on the probability of being unemployed, as measured by the unemployment rate, then regional differences in unemployment rates may themselves contribute to regional wage disparities.

### 3.1.4 Location theory

The models discussed thus far have largely ignored the implications of the spatial distribution of economic activity. Only in the discussion of labour mobility were distance-dependent moving costs introduced. In fact, transportation costs are likely to affect both trade and capital flows as well.[20] The discipline of regional science, which draws on both economics and geography, has traditionally paid more attention to the spatial dimension of economic problems through what is known as location theory.[21] In particular, Weberian location theory applies economic principles to the problem of where individual firms should locate. In the simplest models the market for a firm's output is assumed to be concentrated at a single point in space, but the inputs required by the firm are not all available at the same location. Transportation costs – both the cost of procuring inputs and the cost of distributing output – then become an important element of the firm's profit-maximization problem.

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20 Melvin (1985) considers a simple two-region trade model in which interregional transportation costs exceed international transportation costs for both regions.

21 Discussions of location theory may be found in textbooks on regional economics such as Nourse (1968) and Isard (1975).

Distance enters explicitly into the problem through its effect on transportation costs.

Of course, other factors besides distance and transportation costs affect firms' location decisions.[22] However, distance and transportation costs alone are able to provide some explanations for the observed pattern of industrial location in Canada. The concentration of manufacturing industries in central Canada rather than in the Atlantic provinces can be explained by central Canada's greater proximity to markets in both Canada and the United States. The lower labour costs that might be available to those firms in the Atlantic provinces may be more than offset by the cost of shipping output to distant markets. Other firms find it worthwhile to build plants close to cheap input sources rather than markets. An example is the Alcan plant in Kitimat, British Columbia, which is located next to Alcan's own hydroelectric dam. Recognizing the peculiar locational advantages and disadvantages of particular regions, governments in Canada have offered various types of location subsidies to encourage firms to locate in less desirable regions.

In short, location theory is able to identify some of the structural factors that cause regional disparities to persist. It can be considered a demand-side approach to the labour market, or alternatively, as an explanation of why employment does not grow faster in some high-unemployment regions. In this way it can be viewed as a complement to the neoclassical approach and the natural rate approach, both of which attempt to explain long-run regional disparities.

### 3.2 Dynamic models

While a number of static models are capable of offering explanations for the existence of regional disparities, other popular theories, such as the staples thesis and the polarization hypothesis, do not fit into this category. These two theories are discussed in this section, together with extensions of the standard neoclassical growth model that deal with multi-region economies. Finally, the application of Keynesian macroeconomic models to the problem of regional disparities is considered. As before, the discussion focusses on the contributions that these models can make to our understanding of regional disparities in wage rates and unemployment rates.

22 These factors include the availability of infrastructure and various types of services. Note, however, that poor transportation facilities in some locations will raise transportation costs to and from that location; this additional factor can easily be incorporated in the model. Similarly, if services required by the firm are treated as inputs to production, distance from these services can also be included. Thus, the model is more general than it might seem.

### 3.2.1 The neoclassical growth model

Neoclassical models of economic growth were developed to explain a number of stylized facts about economic growth: the growth rates of capital, labour and output seemed to be fairly constant over time; the capital-labour ratio was increasing over time; the capital-output ratio was relatively constant; and the rate of profit was also fairly constant. What was required was a model in which the steady state was characterized by these stylized facts.

The simple one-sector growth model of Solow (1956) was one of the first to achieve this goal, and it has since been extended in many directions by other authors. The extension that is relevant here is to two-country models of growth and trade. In these models, which were recently surveyed by Findlay (1984), each country produces two goods using two factors of production. Goods are traded, but in the simplest models factors of production are assumed to be immobile.[23] When a number of restrictive assumptions are made (such as identical technologies and identical growth rates of the effective labour force in each region), trade in goods will equalize factor prices as well as goods prices. Thus, a version of the factor-price equalization theorem holds in neoclassical growth models as well.

Carlberg (1981) develops a model of economic growth that is explicitly intended to apply to regions. Unlike the models discussed in the previous paragraph, his model assumes that each region produces only one good, but with different production functions. Regions are also assumed to differ in their savings rates and rates of population growth. Finally, both factors of production, capital and labour, are assumed to be perfectly mobile, and there are no barriers to trade in goods. In this model the assumption of factor mobility ensures that there will be no regional disparities in wage rates in the steady state.

Empirical testing of the neoclassical growth model has taken two forms. The first is sources-of-growth analysis. This approach begins by differentiating the neoclassical production function to obtain the following expression for the rate of growth of output:

$$\hat{Y} = \tau + \alpha\hat{K} + (1-\alpha)\hat{L}\,, \qquad (3)$$

23 Some models assume that capital is mobile, for example Ruffin (1979).

where $\tau$ is the rate of productivity growth, $\alpha$ is the share of capital in total output, and $\hat{X}$ is the percentage rate of growth of X (X= Y, K, L). An attempt is then made to determine the contribution of each factor – technological change, growth of the capital stock, and growth of the labour force – to economic growth. Sometimes output per worker (y) rather than total output is the variable of interest, in which case equation (3) can be rearranged to read

$$\hat{y} \equiv \hat{Y} - \hat{L} = \tau + \alpha(\hat{K} - \hat{L}) . \qquad (4)$$

If desired, the model can be complicated by disaggregating K and L and by allowing various disequilibrium factors to affect the rate of growth of output.

Note that although it focusses on output per worker, given the assumptions of the model, this methodology can provide some insight into regional disparities in wage rates as well. If firms are perfectly competitive, then they will hire labour until the marginal product of labour is equal to the real wage. In the case of constant returns to scale, the marginal product of labour will be directly proportional to output per worker. Thus, as long as the assumptions of perfect competition, perfectly flexible wages and prices, and constant returns to scale hold, the real wage and output per worker should grow at the same rate.[24] This approach can help to identify some of the sources of differences in the rate of growth of real wages.

Auer (1979) is an example of a study that follows this approach using Canadian data. He investigated the causes of regional differences in both the level of productivity (as measured by aggregate output per worker) and the growth rate of output. From 1970 to 1973, output per worker was above the national average in Ontario, Saskatchewan, Alberta and British Columbia, but was significantly below average in the Atlantic provinces. Regional differences in labour quality, as measured by educational attainment, seemed to be the most important cause of regional differences in output per worker in each industry rather than differences in industrial structure. Variations in the capital stock per worker also played a role. As far as regional growth rates were concerned, increases in capital per worker and improvements in labour quality were responsible for 40 per cent of the growth in output per worker in goods-

24 Factors such as tax rates might introduce a wedge between the marginal product of labour and the real wage. However, if tax rates are constant over time, the real wage and the marginal product of labour should still grow at the same rate.

producing industries, with the remaining 60 per cent being accounted for by better management, technology and other factors.

The second approach to testing the neoclassical growth model involves the estimation of simple versions of the model. Two examples are the models of Smith (1975) and Ghali et al. (1978). Smith's model consists of a Cobb-Douglas production function, a proportional savings function, an investment equation, a population growth equation, and equations describing net capital flows and net migration. These functions are assumed to be identical in all regions. The model is solved to yield four reduced-form estimating equations. The four endogenous variables in the model are the rate of growth of output per worker, the rate of growth of the capital stock, the rate of employment growth, and the rate of net migration, while the sole exogenous variable is the level of output per worker. The model is estimated using data for the United States, and Smith draws the following conclusions from his parameter estimates: (i) migrants move in response to income differentials; (ii) capital moves towards regions with a higher rate of return; and (iii) there is a tendency towards the convergence of incomes per worker. One of the major faults of the model, as Smith himself points out, is that it does not recognize the existence of unemployment, and thus the empirical success of the neoclassical model does not imply the rejection of more demand-oriented growth models. He calls for more research on the impact of unemployment on regional growth.

Ghali et al. also estimate a simple neoclassical growth model, but unlike Smith they estimate the structural equations rather than the reduced form of their model. It consists of three equations: an output growth equation, similar to equation (3), and growth-rate equations for both capital and labour. The rate of growth of each factor in region i is assumed to be a simple linear function of the proportional deviation from the national average of the return to that factor in region i, and the proportional deviation of region i's growth rate from the national average. Both explanatory variables are lagged one period in the factor growth equations, giving the model a recursive structure. The model is estimated using 1963 cross-section data for the 48 contiguous American states and the District of Columbia.

The empirical results of Ghali et al. suggest that regional differences in the growth rates of inputs account for about 48 per cent of the variation in regional growth rates. The relationship between factor growth rates and factor price differentials is positive and significant, though regional differences in the growth rate of output seem to affect only the growth rate of the labour force. As a further test of their model, Ghali et al. simu-

late it for 15 periods. They find that regional variation in the growth rates of output and output per worker, as measured by the coefficient of variation, declines rapidly during the first five periods. In contrast, variation in the level of output per worker falls by only 9 per cent after 15 periods. However, complete convergence of levels of output per worker would not be expected if regional production functions were different, rather than identical, as is assumed by Ghali et al.

Thus, in their empirical applications, neoclassical models of economic growth can provide some insight into the factors underlying regional differences in the rate of wage growth. However, they do not seem to offer additional explanations for regional differences in wage levels in the long run. Despite this limitation, a more thorough analysis of the dynamic properties of neoclassical regional growth models would no doubt increase our understanding of how regional disparities evolve as the economy moves towards its long-run steady state.

### 3.2.2 The staples thesis

The export-base or staples approach treats the demand for regional exports as the principal determinant of economic growth. Better known in Canada as the staples thesis, it was developed by Canadian economists H.A. Innis and W.A. Mackintosh. The staples thesis views economic growth as the result of the exploitation of a series of staple products, where staples are defined to be export goods with a high natural resource content. Though the thesis was initially intended to explain the development of Canada, it applies equally well to regions.

According to the staples thesis, growth begins with the emergence of foreign demand for a staple product. This foreign demand may arise as the result of a change in tastes or because new technological developments have led to a reduction in the staple good's cost of production. Generally, it is assumed that the region is initially short of the capital and labour necessary to develop the staple; however, the high returns to developing the staple will raise the returns to the capital and labour employed in its production, prompting the inflow of both factors from other regions.

The extent of the economic growth arising from staple production will depend on the strength of various types of linkages. First, there are backward linkages, which involve the development of local industries that supply inputs for the staple's production. The need for transport facilities

has proved to be one of the strongest backward linkages.[25] Next, forward linkages involve the development of secondary industries that use the staple product as an input. Such industries increase the value-added of regional exports. Third, there are lateral linkages, which according to Marr and Patterson (1980) occur "mostly in the form of external economies generated by the export and related industries which stimulated the growth of some third industry."[26] Examples would be the development of a transportation network or the growth of a pool of skilled labour within the region. These types of external economies reduce costs not only for the staple industry but also for other industries, and thus may attract new businesses to the region.

Last, there are final-demand linkages, which are really a type of backward linkage. The term refers to the growth of industries that supply consumer goods and services to the labour employed in the expanding staple industry. As the local labour force grows, so will the local market for goods and services, and it will become more efficient for the region to produce these goods and services locally than to import them from elsewhere. The growth of these industries will in turn stimulate the growth of the regional economy.

If the various types of linkages were fairly strong, the staple industry that had initiated the growth process would gradually become less and less important to future growth. Its share of regional exports would decline as the region's economy became more diversified. But if the linkages were not strong enough, the region would remain vulnerable to fluctuations in world demand for its staple product. A fall in demand would transform the process of growth into one of decline. As the rate of production slowed, workers would be laid off and the rate of capacity utilization would fall. The demand for consumer goods and services would decline, causing a contraction of the tertiary industries serving the local community. Only a revival of demand for the staple, technological changes that reduced the cost of producing the staple, or the appearance of a new staple could arrest the region's decline.

Like location theory, the staples thesis is not a theory of regional disparities in wages and unemployment rates per se. Rather it is a broad description of the process of growth that sees regional fortunes as dependent upon the region's natural resource base. Regions that are benefiting from a boom in world demand for their particular staple export will enjoy

25 Scott (1965), p. 52.

26 Marr and Patterson (1980), p. 13.

high wage rates with a low rate of unemployment, while in less fortunate regions wage rates will be low and unemployment rates high. Thus, the staples thesis attributes regional disparities to differences in regional endowments of natural resources and the vagaries of world demand.

A major problem with the staples thesis is that because it is descriptive rather than analytical it is not easy to test empirically. One attempt to incorporate some of the important features of the staples thesis in an analytical model was made by Copithorne (1979). He added natural resources as a third factor of production in both the static and dynamic versions of a simple trade model. In the static version of the model, under the assumptions that the region is a small open economy and there are constant returns to scale, he finds that the region's wage rate is independent of its resource endowment. This result also holds in the dynamic version of the model. One problem with the analysis, though, is that Copithorne's simplifying assumptions would prevent the equalization of regional wages even if labour were perfectly mobile. Thus, the model is really only applicable in the short run. Alternative formulations of the model need to be investigated.

Keynesian models, with their emphasis on aggregate demand, can also be viewed as export-based models. Ghali et al. (1981) tried to test the export-base approach using the following growth rate equation derived from the equilibrium condition for a simple Keynesian model:

$$\hat{Y}_i = \beta_1(w_1\hat{I})_i + \beta_2(w_2\hat{G})_i + \beta_3(w_3\hat{X})_i \,, \qquad (5)$$

where $\hat{Y}$ is the growth rate of income, $\hat{I}$ is the growth rate of investment, $\hat{G}$ is the growth rate of government expenditures, $\hat{X}$ is the growth rate of exports, and $w_1,\ldots,w_3$ are the lagged ratios of I, G, and X to income respectively. However, when they estimated this equation using regional data for the United States they found the coefficient of $\hat{X}$ to be negative and insignificant. They attribute this unexpected result to the poor quality of the available data on regional exports.

Both the Keynesian and Copithorne approaches capture some of the features of the staples thesis, but both ignore the linkages between industries that are a crucial part of the staples thesis. Furthermore, because different staples encourage different types of linkages, the nature of the staple itself is an important determinant of the rate of growth in the staples thesis. Until these features of the staples thesis can be incorporated in an analytical model, the staples thesis will remain a descriptive theory that is difficult to test or quantify. As such, its usefulness as a theory of regional disparities is limited. Though it highlights the importance of resource endowments, technological change and factor

mobility in the process of regional growth, it is very difficult to test it against competing theories of regional disparities.[27,28]

### 3.2.3 The polarization hypothesis

Among the static and dynamic theories discussed thus far, the staples thesis is one of the few that has acknowledged the importance of economies of scale. According to the staples thesis, external economies become available to a variety of industries as a regional economy expands, encouraging the growth of secondary and tertiary industries. However, the existence of a staple export and the strength of its linkages with other industries remain the primary determinants of growth. The polarization hypothesis, however, accords internal and external economies of scale the primary role in determining a region's rate of growth.

One of the first proponents of the polarization or cumulative causation hypothesis was the Swedish economist Gunnar Myrdal in his book *Economic Theory and Under-developed Regions*. The central argument of the polarization hypothesis is that economic growth is not only cumulative, but also tends to become polarized geographically. This polarization occurs as a result of various types of economies of scale, or agglomeration economies, which become available to firms in growing areas.[29] These agglomeration economies include: economies of scale internal to the firm; transfer economies, which result when firms that supply inputs to one another are located in the same centre; external economies of scale that are internal to a particular industry; and urbanization economies, such as the availability of public and financial services and an improved transportation network.

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27 Recently the Economic Council carried out a research project that was very much in the tradition of the staples thesis. Its study entitled *Western Transition* [see also Norrie and Percy (1981), (1982) and (1983)] tried to answer the question of whether or not a shift in economic activity to the West was underway. One of their primary concerns was whether or not the western economies were diversifying as they grew; another was the impact on the Canadian economy of the oil rents accruing to the Alberta government. However, aside from some consideration of the effect of oil rents on migration, these studies have little to say about wage and unemployment rate disparities.

28 Melvin (1987a) suggests that some of the implications of different regional resource endowments for regional disparities can be modelled using the specific factor model of international trade. In this model the specific factor is not mobile between industries or regions. He further explores this model in Melvin (1987b).

29 The centre of growth may be thought of as a region, or as a particular urban area or "growth pole."

As in the staples thesis, capital and labour mobility and trade in goods and services provide the mechanisms through which polarized growth occurs. However, the polarization hypothesis goes beyond the staples thesis by arguing that these flows of goods and factors will tend to benefit the faster growing regions at the expense of slow-growth areas. According to the polarization hypothesis, labour migration is selective: it drains slow-growth regions of their youngest, healthiest and most skilled workers, thereby reducing the quality of the labour force that remains. Similarly, investment in growing regions will spur further growth, and the increased growth will in turn attract even more investment. Finally, as exports of goods and services from growing regions rise, firms will be able to increase their comparative advantage by raising output and reaping the benefits of increasing returns to scale.

Myrdal suggests that the growth occurring in certain centres will have two types of effects on other regions. "Spread effects" will allow regions around the centre of expansion to share in some of the benefits of growth. Typically the regions affected will be sources of raw materials for firms located in the expanding centre. However, there will also be undesirable "backwash effects," which include the negative impact of outflows of capital and labour. Myrdal argues that the backwash effects will tend to be stronger than the spread effects, resulting in an ever-increasing gap between rich and poor regions. Only government intervention will be able to offset the process.

Like the staples thesis, the polarization hypothesis is a descriptive theory of economic growth. As was the case with the staples thesis, empirical testing of the polarization hypothesis requires that its essential features be embodied in a more rigorous analytical model. Dixon and Thirlwall (1975) have attempted to do so by specifying a model of a single region's economic growth that incorporates elements of both the polarization hypothesis and the staples thesis. They postulate that the rate of growth of output in a region will depend primarily on the rate of growth of demand for the region's exports. The demand for exports depends in turn on the domestic price of exports, the foreign price of exports, and world income. Domestic prices are assumed to be a simple markup of unit labour costs. Finally, the impact of agglomeration economies on the growth rate is implicit in an equation that embodies Verdoorn's Law, the proposition that productivity growth depends on the rate of growth of output.

Dixon and Thirlwall solve their model to obtain an expression for the region's equilibrium growth rate. Differences in any of the underlying parameters of the model will cause regional growth rates to differ. They then add some dynamics to the model by introducing lags in the adjustment of export demand and analyze the stability of the model. They con-

clude that given plausible parameter values, regional growth rates are unlikely to diverge.

One problem with Dixon and Thirlwall's model is that it does not incorporate interactions between regions. Faini (1984) builds an alternative model of cumulative causation that does include such interactions. He begins with a two-region, two-sector trade model in which there are increasing returns to scale in one of the two sectors. Labour is assumed to be perfectly mobile between the two regions, which ensures that wage rates will always be equalized.[30] One good is traded and can be either consumed or invested. The other good is nontradable and is used as an input in the production of the traded good. It is in the production of the nontraded good that there are increasing returns to scale. As a result of these increasing returns, increases in output and investment in the nontraded goods sector will change the relative prices of the two goods and of capital. As the price of nontraded goods falls, demand will increase, and the output of both goods will rise. Thus, the presence of increasing returns to scale in the model causes growth to occur even in the absence of technological change or population growth. Faini solves for the model's steady-state equilibrium, but finds that it is unstable. He therefore concludes that "if we are in the range where economies of scale prevail powerful forces will work toward making growth paths diverge."[31]

The problem with the models of both Dixon and Thirlwall and Faini is that while they do address the issue of differences in regional growth rates, they have little to say about regional differences in wage rates or unemployment rates. The model of Dixon and Thirlwall describes the growth of a single region and assumes that the rate of growth of money wages is exogenous. Faini assumes perfect mobility of labour, thereby ensuring that wage rates are equalized across regions at all times. Thus, once again, it seems that unless there are barriers to labour mobility, regional disparities in wage rates will be eliminated in both the short and the long run.

### 3.2.4 The Keynesian approach

One objective of macroeconomic theory has been to explain the existence of fluctuations of the unemployment rate about its natural level. In Keynesian models these fluctuations are in part the result of wage and

30 Because migration will always equalize wage rates, Faini assumes in the remainder of his analysis that the wage rate is fixed.

31 Faini (1984), p. 315.

price rigidity. Because wages and prices respond slowly to economic shocks, the labour market will not clear immediately, and thus gaps between the actual and natural rates of unemployment may persist for some time. In the long run, however, wages and prices will adjust through a Phillips curve mechanism, and the economy will return to full employment. The speed with which this adjustment takes place depends on the responsiveness of wages to the unemployment rate gap (i.e., the slope of the Phillips curve) and on the rate at which price expectations adjust.

In the Keynesian model, gaps between the actual and natural rates of unemployment are simply part of the economy's response to shocks. These gaps will appear at both the national and the regional level and will fluctuate over the course of the business cycle. However, the size of the gaps will differ across regions only if regions differ in economic structure. Thus, the application of the Keynesian model to regions introduces another factor that will affect the magnitude of regional disparities in unemployment rates when wages and prices are not perfectly flexible: regional differences in economic structure.

Evidence on regional differences in economic structure in Canada is available from a number of studies. For example, the work of Johnson and Kneebone (1987) indicates that labour demand functions do differ across regions. Other evidence is available from studies that have estimated simple macroeconomic models of the regional economies, allowing the parameters of the models to differ across regions. The first to attempt such a task using Canadian data were Guccione and Gillen (1974). Their model consists of 25 equations, with consumption, investment, employment, private output and government output equations for each of five regions. Despite many data problems, they were able to estimate the model for the Maritime provinces, Quebec, Ontario, the Prairies and British Columbia for the period 1947-69.

Though Guccione and Gillen do not formally test to see whether or not the estimated coefficients are identical in all regions, the parameter estimates do appear to differ across regions. These differences are particularly apparent in the short- and long-run multipliers for a change in government expenditures. For example, the long-run own expenditure multiplier for Ontario is 2.536, compared to 1.308 for the Maritimes, 1.525 for Quebec, 1.675 for the Prairies and 1.163 for British Columbia. Ontario also seems to benefit more than the other regions from changes in government expenditures outside its borders. Miller (1980) and Miller and Wallace (1983) estimated similar models using different data sets and sample periods, and they too found regional differences in the parameters of their models.

The Phillips curve is another important element of a region's economic structure. The slope of a region's Phillips curve will help to determine how fast it responds to an economic shock. As is the case with aggregate Phillips curves, regional Phillips curves are difficult to estimate and often do not fit well.[32] Despite these problems, several authors have reported regional Phillips curve estimates for Canada. Using data for the period 1946-58, Kaliski (1964) estimated Phillips curves for five regions of Canada. His equations fit well and indicated that regional differences do exist in the response of wage inflation to unemployment. Thirsk (1973) used data for the period 1953-70 to estimate Phillips curves for all of the provinces except Prince Edward Island, but most of the curves fit poorly, with values of $R^2$ less than 0.5. The response of wage inflation to changes in regional unemployment rates did, however, vary across regions; in fact, the coefficient of the unemployment rate was insignificant in several regions. Rabeau (1986) obtained better results, using both quarterly data on average weekly earnings and wage contract data. He too found that the degree of sensitivity to local labour market conditions, as measured by regional unemployment rates, differed across regions. He also reports that his results were somewhat sensitive to the sample period, particularly when average weekly earnings data were used for the dependent variable. With this data set the coefficient of the unemployment rate was insignificant in the equation for the Atlantic region.

Though none of these authors used formal statistical tests for the equality of coefficients across regions, their results suggest that the degree of sensitivity of regional rates of wage growth to regional unemployment rates differs across regions in Canada. Wages will therefore respond to unemployment rate gaps faster in some regions than in others. This in turn means that some regions will adjust to shocks faster than others.

Additional evidence regarding regional responses to changing economic circumstances over the business cycle is provided by Raynauld (1988). He used a Bayesian vector autoregression model to examine fluctuations in employment in Ontario and Quebec over the period 1966M1 to 1984M7. He found that employment in Ontario responded faster to a shock from the U.S. economy than did employment in Quebec, though the long-run effects of the shock were similar in both regions. These results provide further support for the hypothesis that regions differ in economic structure. Though the corresponding effect on regional unemployment

32 For example, Riddell (1980) attempted to estimate Phillips curves for Newfoundland and Ontario, but felt that his results were not worth reporting.

rates would depend on labour force movements as well as changes in employment, the faster response of the Ontario economy to shocks and the fact that Ontario has a relatively low unemployment rate suggest that unemployment rate gaps between regions may widen during an upturn and narrow during a downturn.[33]

The empirical evidence, therefore, suggests that because of regional differences in economic structure, regions are likely to respond differently to economic shocks. This in turn suggests that variations in the magnitude of regional disparities should be expected over the course of the business cycle. More attempts to apply macroeconomic models of the business cycle to regions would no doubt help to increase our understanding of the nature of these fluctuations. However, these models need to be modified in order to make them more applicable to regions. In particular, interregional trade and factor flows need to be incorporated, since they are important elements of the regional adjustment process.

### 3.3 Summary

Though neither static nor dynamic models are capable of explaining all aspects of regional disparities, both have something to contribute to our understanding of the problem. The various static models suggested a number of possible causes of regional disparities. Barriers to trade and to the movement of capital and labour, increasing returns to scale, wage and price rigidities, and regional differences in the determinants of the natural rate of unemployment were all identified as factors contributing to regional disparities in wage and unemployment rates. Because many of these factors are permanent features of the economy, it is unlikely that regional disparities will ever be completely eliminated.

The dynamic models introduced some other factors that may affect regional disparities, such as regional resource endowments and business cycles. However, they were unable to provide any new explanations for the existence of long-run disparities in wage and unemployment rates. This failure can be attributed in part to the lack of well-developed analytical versions of some of these theories, such as the staples thesis and the polarization hypothesis. Further development of these and other dynamic models would probably add a great deal to our understanding of the evolution of regional disparities.

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33 This is what seems to have happened to regional unemployment rate disparities in Canada during and after the 1982 recession. See Figure 1.

An important empirical question that has yet to be answered is the contribution of each potential causative factor to the observed level of regional disparities. Without some idea of the importance of each factor, it will be difficult to design effective policies to reduce disparities. As more and better regional data become available, econometric research and regional general equilibrium modelling should be able to shed some light on this issue.

## 4 IMPLICATIONS OF REGIONAL DISPARITIES FOR AGGREGATE WAGE INFLATION

Most analyses of the role and conduct of monetary policy have been carried out within the context of aggregate economic models. These models implicitly assume that all economic relationships satisfy the conditions required for aggregation and that the geographic location of economic activity is irrelevant to the conduct of monetary policy. However, in the face of large regional differences in key economic variables such as the unemployment rate, one might well ask whether or not these assumptions are valid and what would be the implications for monetary policy if they are not.

There does not seem to have been a great deal of empirical research on this issue, though some of the research cited in Section 3 does have a bearing on it. The work of Guccione and Gillen (1974), Miller (1980), and Miller and Wallace (1983) suggests that the parameters of consumption and investment functions do differ across regions in Canada, while Johnson and Kneebone (1987) found that labour demand functions in the ten provinces are not identical. In the case of the Phillips curve, the estimates of Rabeau (1986) suggest that the inflation-unemployment rate relationship differs across regions in Canada. Finally, while no Canadian study has investigated regional differences in money demand or supply, Hogan and Kaufman (1977) investigated the money multiplier relationship both at the aggregate level and for one Federal Reserve district in the United States. They found that "demand deposits by state do adjust differently in response to reserve changes...[this] result indicates that the behavioural relationships that go into determining the money multiplier differ from state to state."[34]

Thus, there does seem to be evidence to suggest that aggregate economic relationships differ significantly across regions in Canada and in other countries. This in turn means that the effects of a monetary policy conducted at the aggregate level will vary across regions. However, the fact that all regions do not respond in the same way to monetary policy does not in itself imply that monetary policy should be conducted differently when regions are heterogeneous. The crucial question from the point of view of policy makers is whether or not the actions required to achieve a given policy goal at the aggregate level will be different when regions are not homogeneous. The first step towards answering this question would be to compare the effects of specific monetary policy actions in multi-region models with those in standard single-region models.

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34 Hogan and Kaufman (1977), pp. 86-87.

Since it is beyond the scope of this paper to re-examine all of macroeconomic theory within the context of a multi-regional economy, this section will focus on one particular macroeconomic relationship: the Phillips curve. Though its theoretical foundations are somewhat weak and its existence has often been called into question over the years, the Phillips curve remains an important part of many macroeconomic models. In models used for forecasting and policy simulation, for example, it is an important element of the mechanism through which changes in aggregate demand are transmitted to the rate of price inflation. For this reason it would be interesting to examine the implications, if any, for aggregate wage inflation of regional differences in the parameters of the Phillips curve and regional disparities in unemployment rates.

## 4.1 The aggregation hypothesis[35]

Lipsey (1960) was the first to consider the implications of differences in labour markets at the micro level for the aggregate Phillips curve. He believed that such differences might explain the observed loops in the Phillips curve. Assuming identical nonlinear Phillips curves in each sector, he showed that changes in the distribution of unemployment across micro labour markets could cause aggregate wage inflation to increase, even though the aggregate unemployment rate was unchanged. Archibald (1969) extended Lipsey's results by defining more precisely the conditions under which changes in the distribution of unemployment rates that increased their dispersion across sectoral labour markets would increase aggregate wage inflation.[36]

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35 This hypothesis is often referred to in the literature as the nonlinear aggregation hypothesis, since it was first proposed by Lipsey (1960) in the case of an economy where Phillips curves were nonlinear. However, since the argument still applies when Phillips curves are linear, it is referred to here simply as the "aggregation hypothesis."

36 Regional dispersion of unemployment rates can be defined as the degree of inequality of regional unemployment rates. Two possible measures of dispersion are the standard deviation and the coefficient of variation, both of which are defined in footnote 3. Note that a redistribution of unemployment across regions may either increase or decrease dispersion.

Archibald's discussion of the issue proceeded along the following lines.[37] Suppose that the economy can be divided into two regions, 1 and 2, and that region i's Phillips curve has the following general form:

$$\hat{w}_i = \hat{p}_i^e + f_i(u_i - \bar{u}_i)\,, \; i = 1, 2, \tag{6}$$

where $\hat{w}_i$ is the percentage rate of change of nominal wages, $\hat{p}_i^e$ is the expected rate of inflation, $u_i$ is the unemployment rate in region i, and $\bar{u}_i$ is region i's natural rate of unemployment. It is assumed that $f_i'(\cdot) < 0$ and $f_i''(\cdot) \geq 0$. Aggregate wage inflation ($\hat{w}_N$) and the aggregate unemployment rate ($\hat{u}_N$) are defined to be

$$\hat{w}_N = \alpha\hat{w}_1 + (1-\alpha)\hat{w}_2\,, \tag{7}$$

and

$$u_N = \alpha u_1 + (1-\alpha)u_2\,, \tag{8}$$

where $\alpha$ is region i's share of the labour force. Substituting (6) into (7), one obtains the following expression for the aggregate Phillips curve:

$$\hat{w}_N = \alpha\hat{p}_1^e + (1-\alpha)\hat{p}_2^e + \alpha f_1(u_1 - \bar{u}_1) + (1-\alpha)f_2(u_2 - \bar{u}_2). \tag{9}$$

In the initial situation region 1 is assumed to have both the higher unemployment rate and the larger unemployment rate gap.

Now suppose that some shock to the economy causes unemployment to be redistributed between regions in such a manner as to leave the aggregate unemployment rate unchanged; i.e., such that

$$du_N = \alpha du_1 + (1-\alpha)du_2 = 0\,. \tag{10}$$

Labour is assumed to be immobile between regions, so that the labour force shares of the two regions do not change. Suppose further that the change consists of an increase in $u_1$ accompanied by a decrease in $u_2$.

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37 The aggregation hypothesis is quite general in that it assumes only that there is more than one distinct labour market in the economy. It therefore applies equally well to a regional, industrial or other decomposition of the aggregate labour market. Because regional differences are of interest here, the remainder of the discussion in this section assumes a regional disaggregation. Studies that have considered the importance of industrial differences are Archibald (1969), Wilford and Poe (1975) and Smyth (1979).

Since $u_1$ is initially greater than $u_2$, this change will increase the regional dispersion of unemployment rates.

The effect of this redistribution of unemployment on aggregate wage inflation can be determined by totally differentiating equation (9). Under the assumption that inflationary expectations remain constant, the change in aggregate wage inflation will be given by

$$d\hat{w}_N = \alpha f_1'(\cdot)du_1 + (1-\alpha)f_2'(\cdot)du_2 .$$

Using equation (10), one can rewrite this expression as

$$d\hat{w}_N = \alpha[f_1'(\cdot) - f_2'(\cdot)]du_1 . \qquad (11)$$

Since $du_1$ is assumed to be positive, this dispersion-increasing redistribution of unemployment between regions will increase aggregate wage inflation if

$$f_1'(\cdot) > f_2'(\cdot) . \qquad (12)$$

Since $f_i' < 0$, condition (12) implies that an increase in the dispersion of unemployment rates will increase aggregate wage inflation if the Phillips curve is more steeply sloped in region 2, the region with the lower unemployment rate. Otherwise the increase in the dispersion of unemployment rates will reduce aggregate wage inflation.

It should be noted that as Lipsey (1960) pointed out, this dispersion effect will exist even if the regional Phillips curves are identical, as long as they are also nonlinear. In the case of identical nonlinear regional Phillips curves, the slope of the Phillips curve will always be greatest in the labour market with the smallest unemployment rate gap. Only if regional Phillips curves are both linear and identical will there be no aggregation effect. In this case the aggregate rate of wage inflation will be unaffected by changes in the regional dispersion of unemployment rates.

In the two-region case, then, the results are very clear-cut: as long as the regional Phillips curves are not linear with identical slopes, an increase in the dispersion of unemployment rates across regions will affect aggregate wage inflation. Inflation will be increased if the Phillips curve is steeper in the region with the lower unemployment rate.[38] When there

38 One possible exception to this rule would be the case where $u_1 > u_2$ but $(u_1-\bar{u}_1)<(u_2-\bar{u}_2)$. This case could arise if the natural rate of unemployment in region 1 exceeded that in region 2 by a large margin.

are more than two regions it becomes more difficult to predict the effects of a change in the dispersion of unemployment rates. Consider the general case of n regions. In this case the aggregate rate of wage inflation will be given by

$$\hat{w}_N = \sum_{i=1}^{n} \alpha_i \hat{p}_i^e + \sum_{i=1}^{n} \alpha_i f_i(u_i - \bar{u}_i) ,$$

where the weights $\alpha_i$, i=1,...,n, sum to one. Changes in the rate of wage inflation will be given by

$$d\hat{w}_N = \sum_{i=1}^{n} \alpha_i f_i'(\cdot)\ du_i . \qquad (13)$$

In the case of a redistribution of unemployment across regions that leaves the aggregate unemployment rate unchanged, the following condition will be satisfied:

$$du_n = - \sum_{i=1}^{n-1} (\alpha_i/\alpha_n)\ du_i . \qquad (14)$$

With the help of this expression, equation (13) can be rewritten as

$$d\hat{w}_N = \sum_{i=1}^{n-1} \alpha_i [f_i'(\cdot) - f_n'(\cdot)]\ du_i$$

$$= \sum_{\substack{i=1 \\ i \neq j}}^{n-1} \alpha_i [f_i'(\cdot) - f_n'(\cdot)]\ du_i$$

$$+ \alpha_j [f_j'(\cdot) - f_n'(\cdot)]\ du_j . \qquad (15)$$

Suppose that region j is the region with the tightest labour market (i.e., $(u_i - \bar{u}_i)$ is smallest in region j) and the lowest unemployment rate, and that the change in unemployment rates involves a decrease in $u_j$. Even if the Phillips curve in region j is steeper than that in region n, so that

$$[f_j'(\cdot) - f_n'(\cdot)]\ du_j > 0 ,$$

it is clear from an examination of equation (15) that the sign of $\hat{w}_N$ will depend on how unemployment rates change in the other regions and on

the weights $\alpha_i$ attached to each region. Since there are many possible combinations of $du_1,...,du_n$ that will both satisfy condition (14) and lead to an increase in the dispersion of unemployment rates, it is impossible to draw any unambiguous conclusions about the effects of changes in unemployment rate dispersion on $\hat{w}_N$. Some reductions in dispersion may increase $\hat{w}_N$, while others will cause it to decrease.

Despite this ambiguity in the n-region case, it remains the case that a change in the distribution of unemployment between labour markets will shift the relationship between aggregate wage inflation and the aggregate unemployment rate. In other words, the relationship between these two aggregate variables will be unstable unless all regions have identical linear Phillips curves. If they do not, the behaviour of aggregate wage inflation will be best understood by studying the individual regional Phillips curves.

If there are different regional Phillips curves, there are some interesting policy implications. First, due to the instability of the aggregate Phillips curve, the usefulness of the aggregate unemployment rate as an indicator of the degree of inflationary pressure in the economy would be reduced. This is because changes in the distribution of unemployment may affect the aggregate rate of wage inflation even though the aggregate unemployment rate is unchanged. Second, a policy or a shock that changes unemployment between regions may affect aggregate wage inflation. Only empirical work will be able to determine whether or not this is likely to be the case.

Testing of Lipsey's aggregation hypothesis has taken two forms. The first approach has been to add a measure of regional or industrial dispersion of unemployment rates to the aggregate Phillips curve equation. Among the first to follow this line of investigation was Archibald (1969). Using data for the United States and the United Kingdom, he found that an increase in the regional dispersion of unemployment rates would increase aggregate wage inflation. Thomas and Stoney (1971) reached a similar conclusion, as did Baumann (1983) using Austrian data. However, other studies, including Brechling (1973) and Archibald, Kemmis, and Perkins (1974), found that the coefficient of the measure of regional dispersion was not significantly different from zero. Using Canadian data, Thirsk (1973) obtained the same result. Thus, it is impossible to draw any unambiguous conclusions about the aggregation hypothesis on the basis of this first type of test.

There are several possible explanations for the failure of this type of test to produce conclusive evidence that there is a significant relationship between the dispersion of regional unemployment rates and the aggregate rate of inflation. First, when there are more than two regions the effect

of a given reduction in dispersion will depend on how it was achieved. For example, consider the case of three regions, A, B and C, where $u_A > u_B > u_C$. To simplify matters, assume that the labour force share of each region is the same, and that $|f'_A(\cdot)| > |f'_C(\cdot)| > |f'_B(\cdot)|$. The change in aggregate wage inflation that would result from a redistribution of unemployment across regions, holding the aggregate unemployment rate fixed, will be given by equation (15), which becomes

$$\hat{dw}_n = [f'_A(\cdot) - f'_C(\cdot)]\, du_A + [f'_B(\cdot) - f'_C(\cdot)]\, du_B. \qquad (16)$$

A dispersion-reducing change in the distribution of unemployment could be achieved by (i) reducing $u_A$ and increasing $u_C$; (ii) reducing $u_B$ and increasing $u_C$; or (iii) reducing both $u_A$ and $u_B$ while increasing $u_C$. Since $f'_A(\cdot)-f'_C(\cdot) < 0$ and $f'_B(\cdot)-f'_C(\cdot) > 0$, option (i) will increase aggregate wage inflation; option (ii) will reduce it; and the effect of option (iii) will depend on the relative magnitudes of the two terms in equation (16). If in some years a reduction in dispersion is achieved through option (i) while in other years it is achieved through option (ii), there will not be a stable relationship between the dispersion of regional unemployment rates and aggregate wage inflation. Instead, over the course of the sample period the two types of effects may cancel each other out. The result would be an insignificant coefficient for the dispersion variable in an aggregate Phillips curve.

Second, Robb and Scarth (1974) note that if labour is assumed to be mobile, the weights used to aggregate the regional Phillips curves will change. In this case, even when there are only two regions it becomes impossible to predict the effects of a reduction in dispersion on aggregate wage inflation. Once again, a given change in unemployment rate dispersion may increase aggregate wage inflation in some instances and reduce it in others.

Finally, Holt (1973), Robb and Scarth (1974), and Cook and Frank (1975) point out that there may be a problem with the weighting scheme suggested by Archibald (1969). In his theoretical discussion Archibald uses

labour force weights to aggregate the sectoral Phillips curves, but most empirical studies use a measure of aggregate wage inflation that has been constructed using shares of aggregate earnings as weights. Because earnings shares are not constant, the effect on aggregate wage inflation of a change in regional dispersion will once again become ambiguous.[39]

In light of these difficulties, testing the aggregation hypothesis by estimating regional Phillips curves would seem to be a more fruitful approach. This is the second approach that has been followed in the literature. One can devise a number of tests involving regional Phillips curves that have implications for the aggregation hypothesis. First, it is important to determine whether or not distinct regional Phillips curves actually exist. If regional wage inflation rates depend on the national unemployment rate rather than on regional labour market conditions, then the regional distribution of unemployment rates will have no effect on aggregate wage inflation. Second, there is the question of whether or not regional Phillips curves are linear. If they are nonlinear, then, as Lipsey demonstrated, changes in the regional distribution of unemployment will affect aggregate wage inflation even if regional Phillips curves are identical. Third, if regional Phillips curves are found to be linear, one can test to see whether or not their slopes are identical. Finally, if the empirical evidence suggests that dispersion of unemployment rates does matter, simulations can be carried out to get some idea of the effects of changes in dispersion.

Despite the usefulness of this approach, few studies have tested the aggregation hypothesis by estimating regional Phillips curves. One study that attempted to do so using data for the United Kingdom was Thirlwall (1970). He estimated linear Phillips curves for eight different regions. The slopes of the regional Phillips curves do seem to vary considerably, with the two low-unemployment regions having the steepest Phillips curves. These findings tend to support the aggregation hypothesis and suggest that a redistribution of unemployment from high-unemployment to low-unemployment regions might actually reduce wage inflation in the United Kingdom. In the Canadian case, the results of Thirsk (1973) suggest that linear regional Phillips curves with different slopes do exist in

39 Though earnings weights and labour force weights may be quite different, in the Canadian case the resulting measures of aggregate wage inflation are actually very similar. Therefore, it seems more likely that the first two problems are responsible for the inconclusive empirical results, rather than the incorrect definition of the dependent variable.

Canada. Thirsk found that when he replaced the regional unemployment rate with its national counterpart, the explanatory power of the regional Phillips curve equations decreased. He concluded that "wage changes in a province are closely related to internal labour market conditions and cannot be better explained by reference to conditions in labour markets elsewhere."[40] In a more recent study of regional Phillips curves in Canada, Rabeau (1986) came to essentially the same conclusion. This result held using both average weekly earnings data and wage contract data.

The work of Thirsk and Rabeau suggests that distinct regional trade-offs between unemployment and inflation may exist in Canada. If so, then some sort of aggregation effect is also likely to exist. For the reasons mentioned above, the direction of that effect may vary over time; thus aggregate Phillips curves may overestimate the degree of inflationary pressure in the economy in some periods and underestimate it in others. The question of which effect dominates in which period can only be answered through empirical research.

## 4.2 Wage spillovers

Even if it could be demonstrated either that regional Phillips curves did not exist or that they were both linear and identical, there is another channel through which regional factors may influence the aggregate rate of wage inflation. This channel has appeared in the literature in various forms, all of which are discussed here under the general heading of wage spillovers. Common to each of the variants of this hypothesis is the notion that the rate of wage inflation in region i is for some reason dependent upon the rate of wage inflation in one or more other regions. This notion is particularly appealing because, if true, it could help to explain why on average regional rates of wage inflation are so similar.

There do not seem to be many well-developed theories of why wage spillovers between regional labour markets would occur; rather, most of the explanations for such spillovers are institutional in nature. One argument is that firms or unions that operate in more than one region may bargain at the national level. The result would be equal wage increases for workers in all regions. Another argument is that workers in all regions may have similar inflationary expectations. This might be the case if inflationary expectations were formed on the basis of the nation-

40 Thirsk (1973), p. 57.

al consumer price index rather than its regional counterparts. Third, workers may simply be concerned about their positions relative to their counterparts in other regions. In this case they will demand wage increases similar to those obtained in other regions. A variant of this hypothesis assumes that one region in particular is the dominant or "leading" region and that the transmission of wage increases is unidirectional from this region to all others. Finally, authors such as Brechling (1973) have suggested that because workers are free to migrate to other regions where wage increases are higher, employers may be forced to offer wage increases similar to those offered in other regions in order to retain their employees. This suggestion was followed up by Drewes (1987), who developed a simple wage bargaining model in which the number of quits depends on the gap between the firm's wage offer and the wage offered in the leading region(s). Because it is costly to hire and train new workers, the firm must take into account wage rates in other regions when making its own wage and employment decisions.

If wage spillovers exist, then the aggregate Phillips curve can be rewritten as

$$\hat{w}_N = \sum_{i=1}^{n} \alpha_i \hat{p}_i^e + \sum_{i=1}^{n} \alpha_i f_i(u_i - \bar{u}_i) + \sum_{i=1}^{n} \alpha_i g_i(SP_i),$$

where $SP_i$ is some measure of wage spillovers into region i and $g_i' > 0$. Consider the simple case where region j is the leading region, so that $SP_i = \hat{w}_j$, $i \neq j$, and $SP_j = 0$. The change in wage inflation will be given by

$$d\hat{w}_N = \sum_{i=1}^{n} \alpha_i f_i'(\cdot)\, du_i + \sum_{\substack{i=1 \\ i \neq j}}^{n} \alpha_i g_i'(\hat{w}j) \cdot f_j'(\cdot)\, du_j.$$

Suppose once again that there is a change in the distribution of unemployment which involves a decrease in the unemployment rate in region j. Since the spillover effect is assumed to be positive ($g_i' > 0$), the wage spillovers may more than offset a negative aggregation effect and cause the aggregate rate of wage inflation to increase.

Empirical tests for the existence of wage spillovers generally consist of adding other regions' rates of wage inflation to regional Phillips curves. For example, Thirlwall (1970) added the national rate of wage inflation to the Phillips curves of eight regions in the United Kingdom. In all but two regions this variable proved to have a positive and significant coefficient. For the United States, Brechling (1973) found evidence to support

the hypothesis that there is a spillover of wage inflation from high-inflation to low-inflation regions. In the case of Canada, Thirsk (1973) tested the hypothesis that Ontario was the leading region by adding its rate of wage inflation to the Phillips curves of the other provinces. In most of the equations the coefficient of this variable proved to be positive and significant, although the coefficient of the regional unemployment rate became insignificant in all but one of the equations. Boadway and Green's (1981) finding that the level of the wage rate in Newfoundland is largely determined by the wage rate in Ontario seems to be consistent with Thirsk's results. Drewes (1987) also investigated the existence of wage spillovers in the Atlantic region, using a wage spillover variable that is a weighted average of rates of wage inflation in Quebec, Ontario, the Prairies and British Columbia, with the weights equal to each region's share of out-migration from the Atlantic provinces. He found that wage spillovers have a significant effect on the rate of wage inflation in the Atlantic region. However, Rabeau (1986) found no evidence of interregional wage spillovers.

Thus, it seems that the empirical evidence regarding the existence of interregional wage spillovers in Canada is not very conclusive. The strongest evidence in favour of the existence of such spillovers remains the stylized fact that the pattern of regional wage disparities has remained fairly constant over time. Such stability would not have been possible if average weekly earnings had been growing at very different rates in different regions. Whether this similarity in growth rates has been due to direct wage spillovers between regions or simply a gradual process of interregional adjustment that tends to reduce regional differentials has yet to be determined.

If direct wage spillovers between regions do exist, then policy makers may need to pay attention to large regional differences in rates of wage inflation. Should wages be rising at a much higher rate in one region than in others, this high rate of inflation may quickly be transmitted to other regions through direct wage spillovers. The result would be a higher national rate of inflation than would otherwise be the case. If, however, spillovers do not exist, and regional adjustment mechanisms such as labour migration are very responsive to wage and unemployment rate differentials, large inflows of labour to the high-inflation region should quickly relieve the inflationary pressure in that region. In this case, the rate of wage inflation in that region would soon be reduced. Further research is required to determine which effect dominates in Canada.

### 4.3 Summary

This discussion of the implications of regional variations in unemployment rates and the parameters of the Phillips curve has illustrated some

of the problems that may arise when differences at the regional level are ignored. If significant regional differences exist, policy makers may need to include in their set of economic indicators regional as well as aggregate variables. In addition, aggregate economic relationships may be unstable. In this case, regional models may be better able to predict the effects of changes in policy on aggregate variables than are aggregate models.

However, even in the case of the Phillips curve many questions remain unanswered. For example, though it has been shown that the regional distribution of unemployment rates may affect the aggregate rate of wage inflation, the question of how a given monetary policy action affects the distribution of unemployment rates has not been addressed. Also, other disaggregations of the economy ought to be investigated. It is possible that industrial differences may be more important than regional differences as far as wage inflation is concerned, or that regional differences are the result of differences in industrial structure. Future studies of Phillips curves in Canada may be able to shed some light on these issues.

## 5 CONCLUSION

Regional disparities in wage and unemployment rates do exist in Canada, and there is no shortage of theories that attempt to explain why this is so. Because regions differ in amenities such as climate and the availability of public services, and because moving is costly, we might expect to observe regional disparities even when the economy is in long-run equilibrium. These equilibrium disparities would reflect the value of amenities and the costs of moving, rather than regional differences in welfare. However, because of a lack of empirical work, we do not know which causes of regional disparities are the most important in Canada, or how far disparities are from their long-run equilibrium levels.

Another question that has received little attention in the literature is the implications of regional differences for aggregate variables. The problem here is one of aggregation bias. The Phillips curve example showed that in principle this bias can be important. Unless regional Phillips curves are both linear and identical, changes in the distribution of unemployment across regions will affect the aggregate rate of wage inflation in a manner that cannot be captured by the aggregate unemployment rate. Regional disparities in rates of wage inflation will be important too if there are direct wage spillovers between regions. Though not conclusive, the empirical evidence on regional Phillips curves suggests that regional differences may exist, in which case the aggregate unemployment rate will not be as good an indicator of inflationary pressure in the economy as it would be otherwise. It would be interesting to examine other aggregate economic relationships to see how they might be affected by regional differences.

There are still many questions about regional disparities, their causes, and their effects. Some of these questions can be answered through further development of theoretical models, but others can be resolved only through empirical testing. It is in this area that the literature on regional disparities seems to be most deficient. It is true that a lack of data at the regional level has hampered the development of the empirical literature, as many important variables are not collected regionally. However, it is unlikely that the data that are available have been exhausted. As economists continue to put these data to use, they will add significantly to our stock of knowledge about regional disparities.

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